J.A. Hall

2762

EG&G INC.

INSTRUCTION MANUAL

NUMBER B-3065

15 JULY 1965

MODEL 580 RADIOMETER
MODEL 585 SPECTRORADIOMETER
MODEL 580/585 SPECTRORADIOMETER

MP MASTER

MA29011

PRODUCTS DIVISION

EDGERTON, GERMESHAUSEN & GRIER, INC.

Local Sales Engr Jerry Bachur (213) 464-2800

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64104

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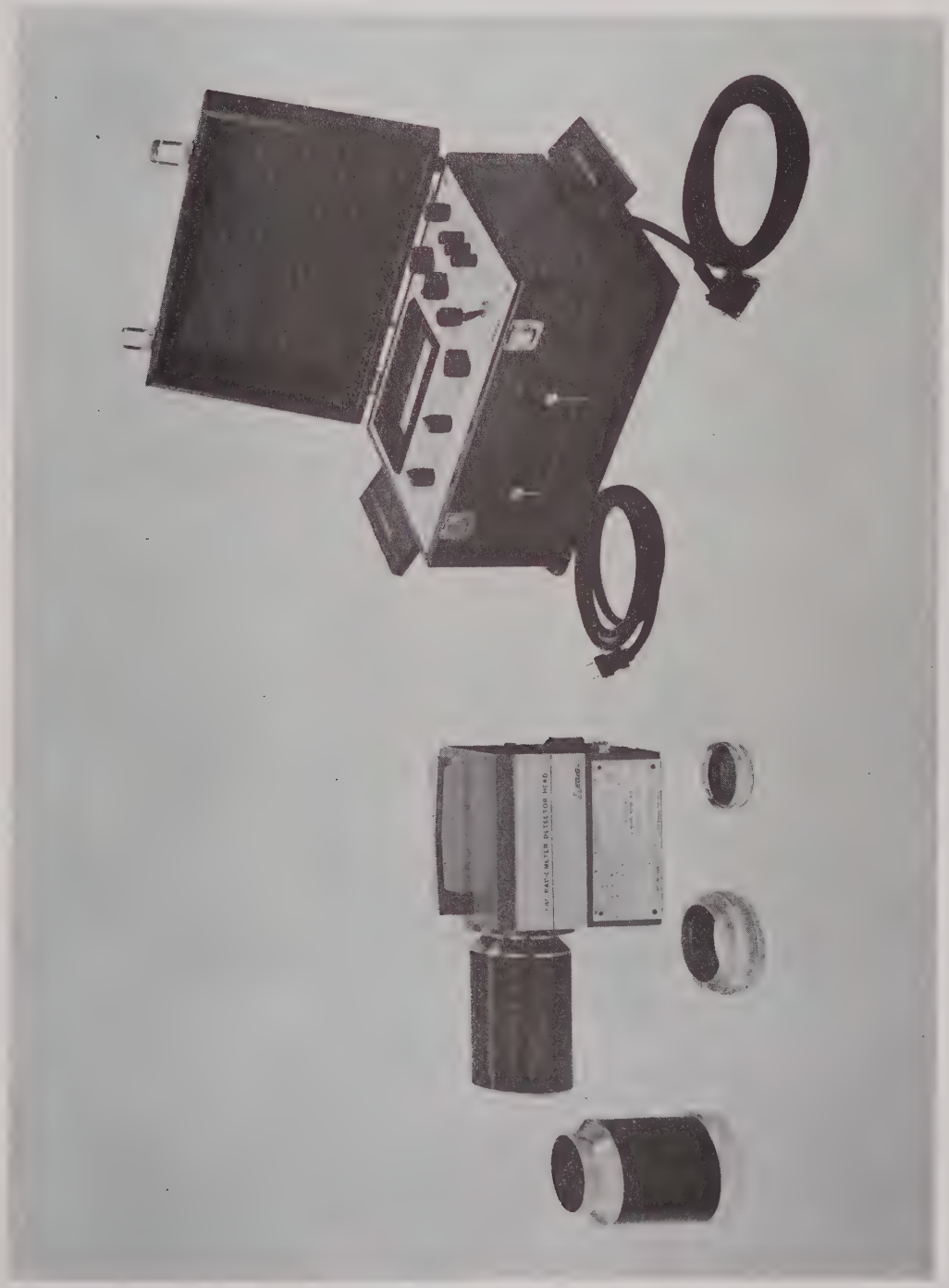

Figure 1-1. Composite View of a Model 580 Radiometer

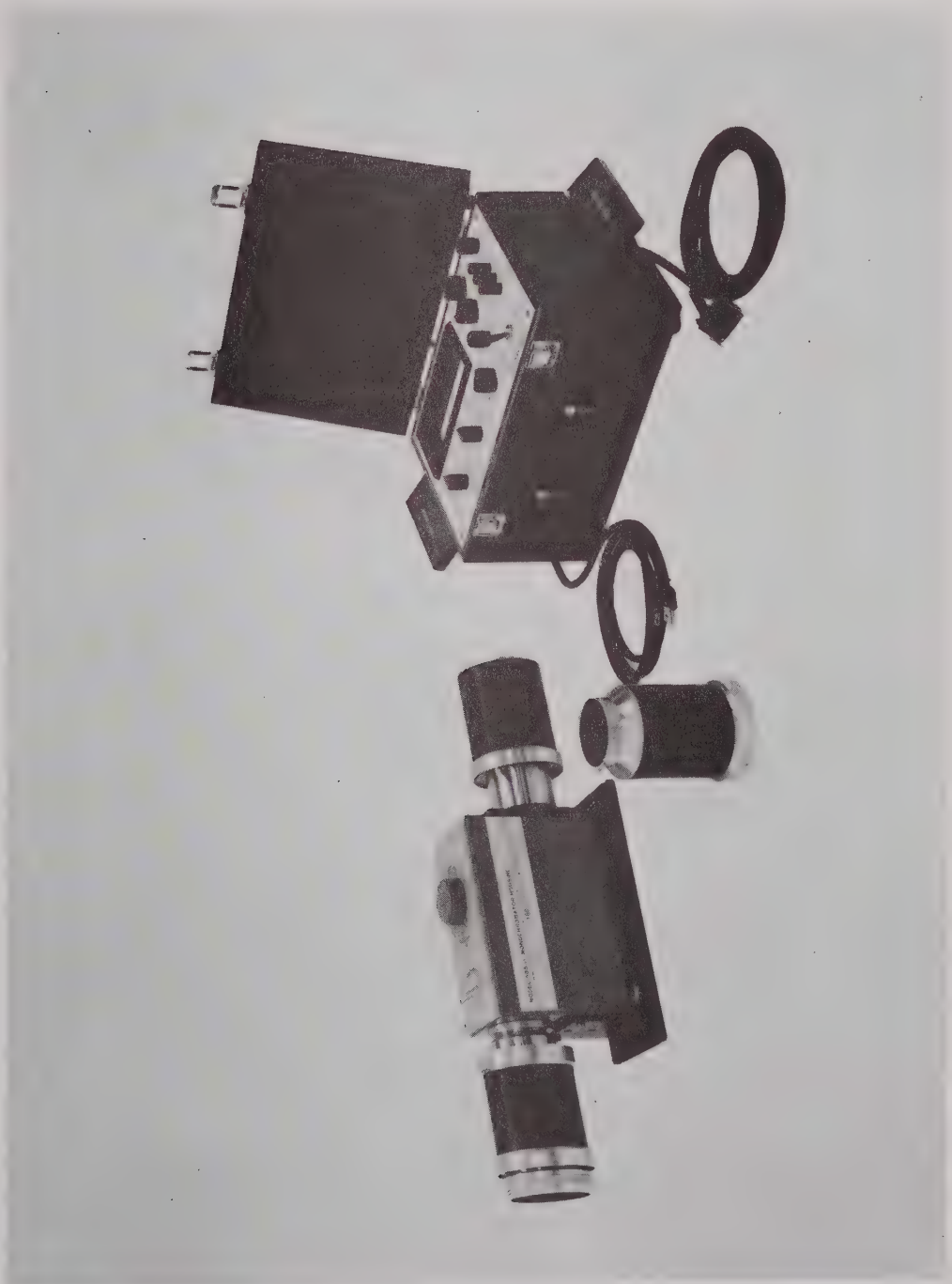

Figure 1-2. Composite View of a Model 585 Spectroradiometer

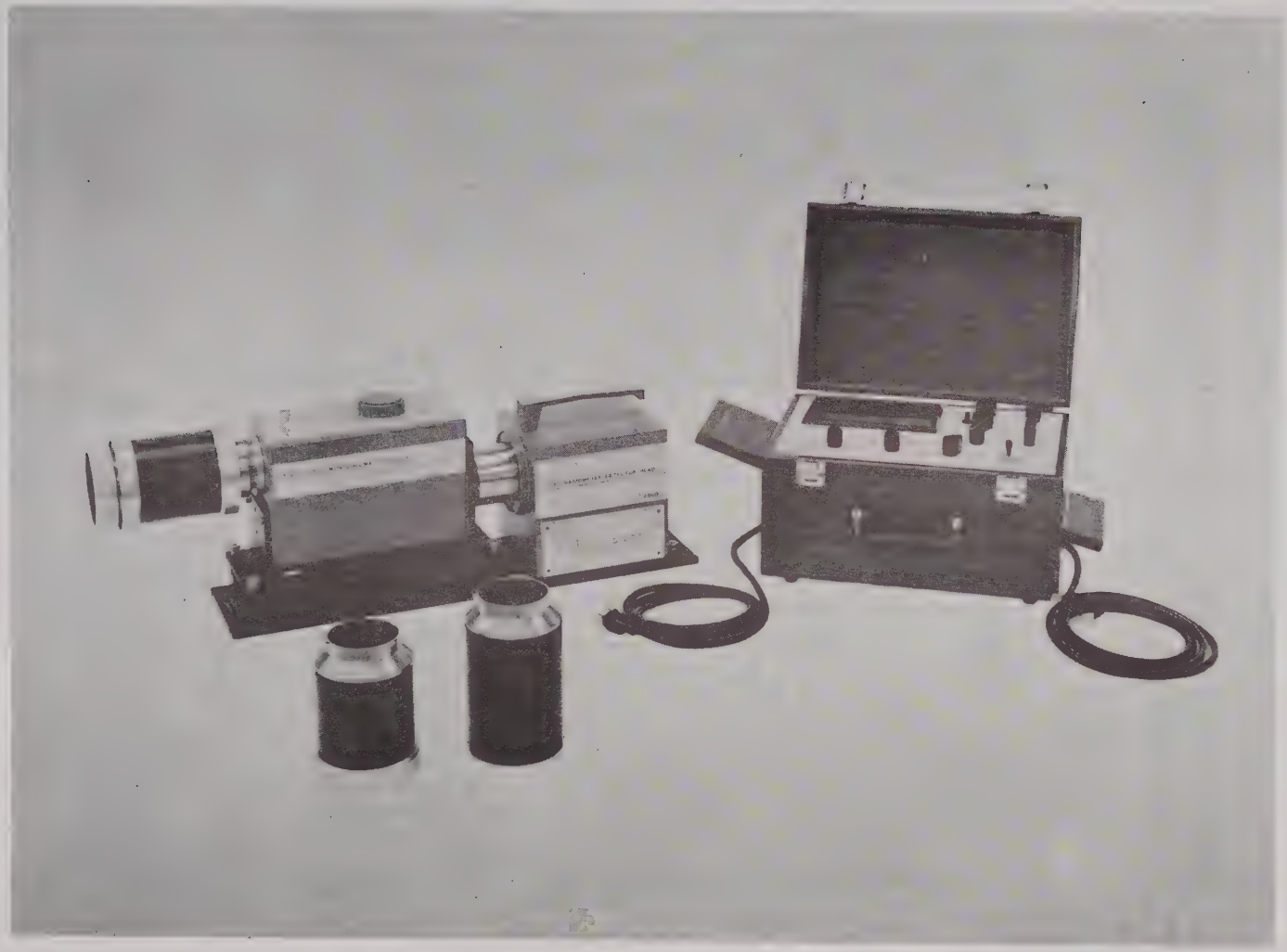

Figure 1-3. Composite View of a Model 580/585 Spectroradiometer

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TABLE 1-1

ASSOCIATED SYSTEMS AND CROSS-REFERENCES

	MODEL 580 RADIOMETER				MODEL 580/585 SPECTRO-RADIOMETER				MODEL 585 SPECTRO-RADIOMETER				Remarks
	S1	S5	S20		S1	S5	S20		S1	S5	S20	UV	
Model 580-11 Indicating Unit	X	X	X		X	X	X		X	X	X	X	
Model 580-22 Detector Head			X				X						
Model 580-23 Detector Head *	X				X								
Model 580-25 Detector Head *		X				X							
Model 585-52 Detector Head											X		
Model 585-53 Detector Head									X				
Model 585-54 Detector Head												X	
Model 585-55 Detector Head										X			
Model 580-31 Viewing Hood	X	X	X		X	X	X						
Model 580-00-31 Photometric Filter		X				X							
Model 585-11 Monochromator Housing					X	X	X		X	X	X	X	
Model 585-22 Grating						X	X			X	X		
Model 585-23 Grating					X				X				
Model 585-24 Grating						X				X		X	
Model 585-20-21 Fixed Slits					X	X	X		X	X	X	X	3.00 mm Exit
Model 585-20-22 Fixed Slits					X	X	X		X	X	X	X	1.50 mm Exit
Model 585-20-23 Fixed Slits					X	X	X		X	X	X	X	0.75 mm Exit
Model 585-20-24 Variable Slits					X	X	X		X	X	X	X	Optional
Model 585-41 Filter Holder	X	X	X		X	X	X		X	X	X	X	Optional
Model 585-20-11 Filter						X	X			X	X		
Model 585-20-12 Filter						X	X			X	X		
Model 585-20-13 Filter					X				X				
Model 585-20-14 Filter					X				X				
Model 585-20-15 Filter						X				X		X	
Model 585-31 Beam Input Optics					X		X		X		X		
Model 585-32 Beam Input Optics						X				X		X	
Model 585-00-11 Adapter (580/585)					X	X	X						
Model 580-00-11 Narrow Beam Adapter	X	X	X		X	X	X						Optional
Model 580-00-12 Laser Beam Sampler	X	X	X		X	X	X						Optional
Model 580-00-13 Laser Monitor	X	X	X		X	X	X						Optional

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION. Three basic systems are available to measure or characterize the spectral output of pulsed or steady light sources. Each of the three systems are explained in this manual. For speedy reference and elimination of duplication, major components of the systems are explained separately. Table 1-1 lists all these major components and indicates simply what components are associated with each system. It should be noted that many components are common to more than one system.

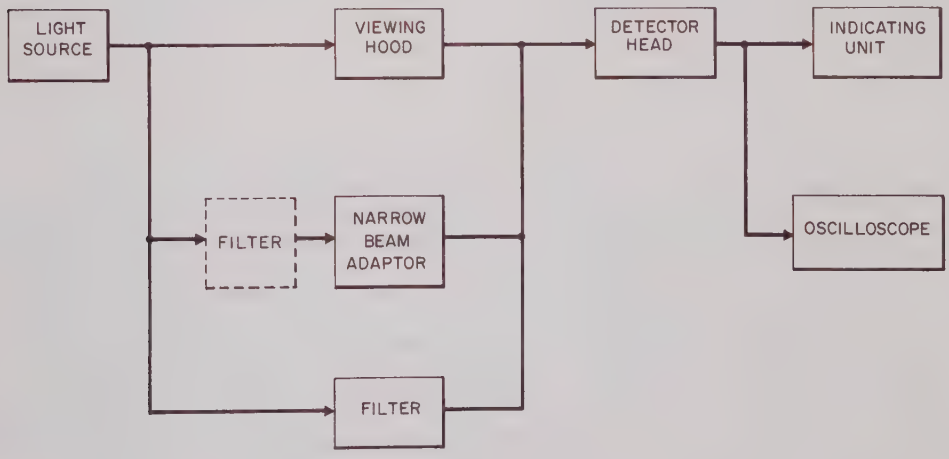


Figure 1-4. Functional Block Diagram of a Radiometer

1.2 MODEL 580 RADIOMETER

1.2.1 The Model 580 Radiometer (Fig. 1-1) is a versatile precision instrument for the quantitative measurement of steady-state or pulsed light. It provides meter readout of irradiance for steady-state sources or integrated irradiance values for pulsed sources. Data for source evaluation; i.e., power, energy, efficiency and beam spread characteristics, can be quickly acquired. The Model 580-20 Series Detector

Heads also have provisions for oscilloscope display of pulsed light signals so that wave shape measurements can be made; i. e., peak power, pulse duration, and rise and fall times.

1. 2. 2 Figure 1-4 illustrates in block diagram form, the light paths using various possible set-ups of the Radiometer.

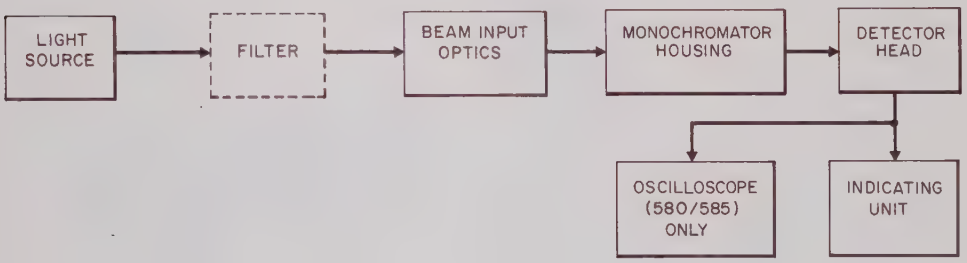


Figure 1-5. Functional Block Diagram of a Spectroradiometer

1. 3 MODEL 585 AND MODEL 580/585 SPECTRORADIOMETERS

1. 3. 1 The Spectroradiometers are used to characterize the spectral output of pulsed or steady light sources. The uniquely functional combination of grating, optics and photo detector electronics provides for absolute irradiance measurements in discrete wavelength bands. Source power or energy measurements are easily made to quickly furnish reliable spectral data.

1. 3. 2 A wide variety of interchangeable gratings, slits, filters and detector photo-sensitive surfaces provide continuously variable spectral coverage. The waveband of interest is easily and accurately dialed from 180 to 1200 mu with simple grating and detector changes.

1. 3. 3 The Spectroradiometers include three basic units (table 1-1); Monochromator Housing, Detector Head, and Indicating Unit. The major

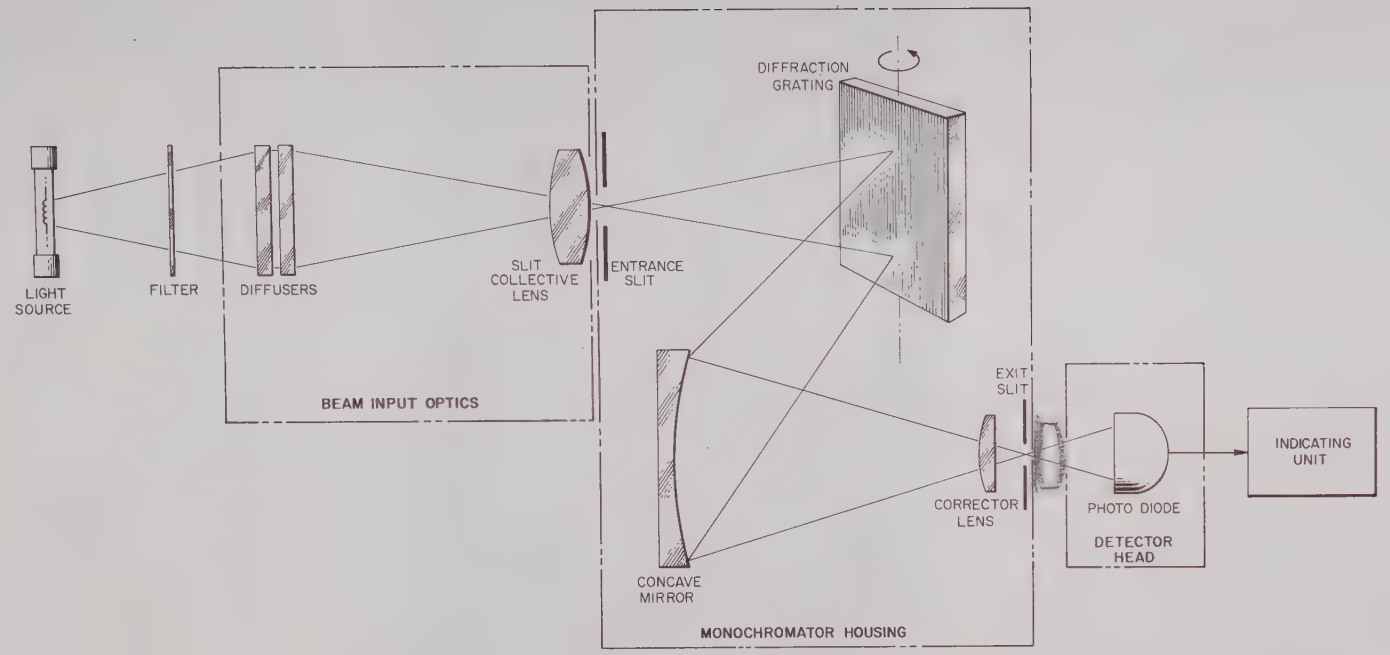


Figure 1-6. Optical Schematic of a Spectroradiometer

optical units (Monochromator with Beam Input Optics, and Detector Head are rigidly mated for stable optical alignment without loss of flexibility provided by interchangeable grating, slit, and detector head combinations. Facilities for oscilloscope display, external bias, and radiometer operation with the Model 580-20 Series Detector Head enables the Model 580/585 Spectroradiometer to be more versatile than the Model 585 Spectroradiometer.

1.3.4 Figure 1-5 illustrates in block diagram form, the light path using a Spectroradiometer. Figure 1-6 illustrates a detailed schematic of the internal light path within a Spectroradiometer.

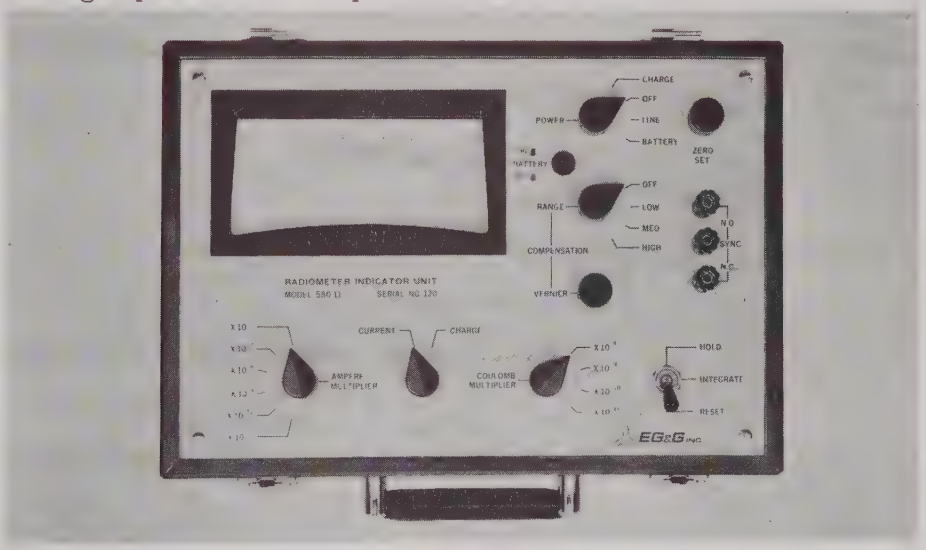


Figure 1-7. Model 580-11 Indicating Unit

1.4 MODEL 580-11 INDICATING UNIT

1.4.1 General. The Model 580-11 Indicating Unit (Figure 1-7) is used with all Radiometer and Spectroradiometer Systems. It serves three major functions; charge-current indicator, system control panel, and power supply. Detector Head interconnecting cable and power cable are stored for easy access through spring-lock ports in the side of the case. The Indicating Unit can be energized from external power or internal battery at the option of the operator. A two-minute warm-up time will

stabilize all circuits.

1.4.2 Characteristics:

Charge Scales: $10X10^{-11}$ to $10X10^{-8}$ coulombs(4 individual switch positions)

Current Scales: $10X10^{-11}$ to $10X10^{-6}$ amperes(6 individual switch positions)

Ambient Compensation: Low, medium, high, and vernier(compensates for the net effect of ambient light level and detector leakage). Maximum compensation current available is more than 4ua.

Min. Pulse Width for Energy Measurement (Meter): 1.0 nanosecond

Power Requirements: 110 volts, 50 to 60 cps (operator's choice of external power or internal rechargeable battery operation)

Battery Operating Time: 6 to 8 hours (depending on amount of compensation used)

Battery Recharge Time: 12 hours

Battery Shelf Life: 1 year

Dimensions: 13 in. long, 8 in. wide, 10 in. deep

Weight: 15 lbs

1.4.3 Controls and Indicator. The Indicator Unit provides measurement flexibility with a minimum number of controls. Indicator and controls are located for ease of operation. Control markings are easily readable and all detent switches have pointer-type knobs for absolute position indications. The following list explains in detail the function of each control.

a. POWER switch: The four-position switch selects the method of energizing the System. Operation from an external ac source or internal battery is optional.

OFF position: All power to the System is shut off. Power indicator lamp is not lit.

LINE position: External line voltage applied. System is energized. Power indicator lamp blinks.

BATTERY position: Internal battery voltage applied. System is energized. Power indicator lamp blinks.

CHARGE position: External line voltage charges internal battery. Power indicator lamp remains lit.

b. BATTERY indicators: The two indicators show the condition of the internal rechargeable battery.

CHG indicator: Hue changes from deep orange at full charge condition to colorless at no-charge condition.

DIS indicator: Hue changes from deep orange at no-charge condition to colorless at full charge condition.

NOTE:

Rate of battery drain depends on the ambient light conditions encountered. Limited experience will permit reasonable operator judgements of the remaining time for battery operation and/or the remaining time to acquire full battery charge.

c. FUNCTION switch: The two-position switch selects the steady-light measuring circuit (current) or the pulsed-light measuring circuit (charge).

CURRENT position: Used for steady-light source measurements. Connects the current measuring circuits to the meter for measurement of signals(amperes).

CHARGE position: Used for pulsed-light source measurements. Connects the charge measuring circuits to the meter for measurement of signals(coulombs).

d. AMPERE MULTIPLIER switch: Six-position switch to select proper meter scale when FUNCTION switch is in CURRENT position.

e. COULOMB MULTIPLIER switch: Four-position switch to select proper meter scale when FUNCTION switch is in CHARGE position.

f. INTEGRATE switch: Three-position switch controls the measurement of a pulsed light event. It can be used with the three synchronizing connectors. (marked N.O. SYNC, and N. C.) on the panel to initiate a pulsed light event. A single-pole double-throw switch (S7) operated mechanically by the INTEGRATE switch acts as a synchronizing trigger. In the RESET position. N.O. connector is disengaged from SYNC connector which is engaged with the N.C. connector. When INTEGRATE switch is placed to INTEGRATE position, SYNC connector engages with N.O. connector and N.C. connector is disengaged. This trigger technique minimizes any uncompensated error due to the pre-flash intergration of ambient light in pulsed light measurements. It also eliminates the uncertainty of manual synchronization of measurement in pulsed light events, except for those of random nature which cannot be triggered.

NOTE:

A smooth manual push action from RESET position through INTEGRATE position to HOLD position at the end of the light event is the proper operating technique for this switch when measuring pulsed light.

RESET position: Discharges integrating circuits and returns meter needle to zero in preparation for measurement of a flash event. This position is the normal position for all current measurements, and meter zero adjustment for charge measurement applications.

INTEGRATE position: Places integrating circuits in ready status for time integrated light measurements.

HOLD position: Disconnects detector circuit after meter displays final reading of pulsed light event to permit accurate observation. Meter drift rate in HOLD position is less than 0.1% full scale in 15 seconds. Position also used for setting the meter zero in current measurements.

g. ZERO SET potentiometer: Establishes electrical zero on meter prior to light measurements.

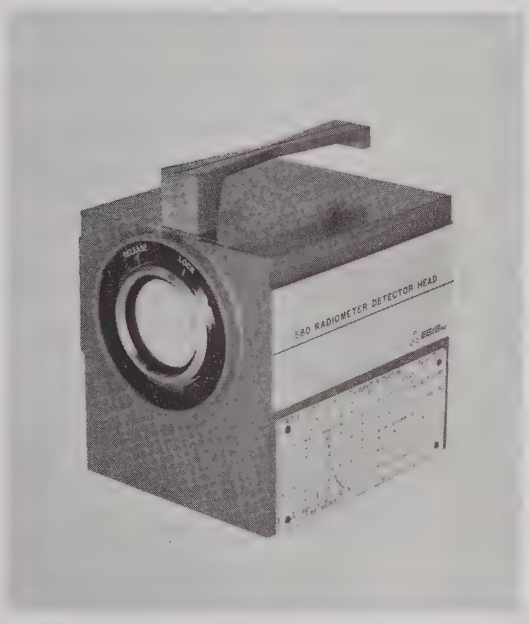
h. COMPENSATION controls: Nullify the effects of normal steady ambient light so that source measurements are essentially direct reading, even in sunlight.

RANGE switch: Selects the compensation range needed to nullify the effects of the normal ambient light. Since the three current scales (low, medium, and high) overlap, correct setting is quickly determined.

VERNIER potentiometer: Adjusts meter zero on indicating meter. Operates in conjunction with RANGE switch.

i. MEASUREMENT INDICATING METER: Microammeter with a 0.5% tracking accuracy. Its construction incorporates a taut band suspension which eliminates hysteresis and mechanical binding problems.

The large meter face is marked from zero to ten. These major scale divisions are further divided into tenths by easily read scale markings. Meter is direct reading in amperes or coulombs as determined by the position of function switch and associated scale setting.



Front and Side View Rear View

Figure 1-8. Model 580-20 Series Detector Head

1.5 MODEL 580-20 SERIES DETECTOR HEADS

1.5.1 General. The Model 580-20 Series Detector Heads are identical to each other except for the useful range of spectral response. Each Detector Head houses a photoemissive detector to cover the selected spectral band, a diffuser disc, a selectable aperture system, and circuitry for input power and output signal. All Series 20 Detector Heads are designed to operate with the Model 580-11 Indicating Unit for meter readout. Facilities are also available for oscilloscope display of light

waveforms and separate detector bias from an external power supply. Optically, the diffuser disc accepts light in a 14-degree field of view through the Model 580-31 Viewing Hood. The diffused light then fully illuminates the sensitive area of the photo diode (regardless of aperture setting) for conversion to an electrical current for display and measurement. The amount of diffused light viewed by the photo diode is controlled by the area of the aperture selected. Eight steps of attenuation are provided by the aperture disc system. The photo diode is energized electrically to function as a linear current generator with output amplitude dependent upon the intensity of the received light. This output current is applied to the current (steady) or charge (pulsed) measuring circuits of the indicator unit or to a suitable oscilloscope.

1.5.2 Functional Controls. The Detector Heads have all controls located on the rear panel. Controls are arranged for ease of operation and are easily readable; all detent switches have pointer-type knobs for absolute position indications. The following list explains in detail the function of each control.

a. NEG BIAS VOLTAGE switch: The two-position switch selects the method of energizing the detector head.

INT position: Energizes the detector head from the power supply in the Model 580-11 Indicating Unit.

EXT position: Energizes the detector head from any suitable external dc power supply through BNC type connector.

b. SIGNAL switch: Provides a means to monitor output current signals either with the Model 580-11 Indicating Unit or an external oscilloscope.

INT position: Output current signals measured with the Model 580-11 Indicating Unit.

EXT position: Output current signals measured with external instruments.

c. EXTERNAL VIEWING MULTIPLIER (Mv) switch: Provides three steps of signal sensitivity for oscilloscope viewing of pulsed light signals.

OPEN position: Used when direct connection to photo diode with external readout (no load resistor) is desired.

X1 position: Furnishes a direct signal to oscilloscope (across 5000 ohm resistor to ground)

X10 position: Attenuates output voltage to oscilloscope by 10 (500 ohms to ground)

X100 position: Attenuates output voltage to oscilloscope by 100 (50 ohms to ground)

d. APERTURE MULTIPLIER (Ma) switch: Provides eight steps of attenuation to the viewed light signal extending the dynamic range of the instrument optically. Switch positions are marked according to attenuation factor (1, 3, 10, 30, 100, 300, 1000, and 3000). Built-in compensation makes aperture ratios accurate when the diffuser disc is fully illuminated by uniform source irradiance and meter readout is employed.

NOTE:

Aperture multiplier positions are within 5% accuracy when using external positions of Detector Head; i. e., scope readout. When the Model 580-11 Indicating Unit is used, accuracy is within 1%.

1.5.3 Visual Alignment Aids. Permanent markings on the handle and each side nameplate of the Detector Head are visual alignment aids. The nameplate and handle center lines coincide with the central axis of the Detector optical system. They are used as sighting aids in the vertical and horizontal planes. Additional diverging lines on the handle

outline the 14-degree field of view intercepted by the Model 580-31 Viewing Hood. The position of the active detector surface (diffuser disc) from which light source-detector distances are measured, is labeled on the top of the Detector Head. This line coincides with the front surface of the detector diffuser. Specifications: The following specifications pertain to all Model 580-20 Series Detector Heads.

TABLE 1-2

MODEL VARIATIONS

	Model 580-22	Model 580-23	Model 580-25
Photo Surface	S20	S1	S5
Spectral Range (mu)	350-850	350-1150	200-775

a. Peak Current (amperes): $150X10^{-3}$ with 150 volt internal bias; 1.0 with 1000 volt external bias.

b. Average Current: $10X10^{-6}$ amperes

c. Effective Active Area of Head: 2.01 sq. in.; 12.97 cm^2

d. Viewing Resistors (ohms): Infinity (open), 50 (X100), 500 (X10), 5000 (X1)

e. Pulse Rise Time (scope viewing): less than 1 nanosecond with 1KV bias

f. Aperture Ratios: 1, 1/3, 1/10, 1/30, 1/100, 1/300, 1/1000, 1/3000

g. Physical Characteristics:

Length: 6.5 in. (12.5 in. with 3.5 in. dia. hood)

Width: 5.25 in.

Height: 7 in.

Weight: 8 lbs

Figure 1-9. Model 585-50 Series Detector Head

1.6 MODEL 585-50 SERIES DETECTOR HEADS. The Model 585-50 Series Detector Heads are similar in construction but contain different photo diodes for the various ranges of spectral response. The Detector Head housing contains the photo diode, quartz window, and connector. The clear quartz window is retained to the front of the cylindrical housing by the lens holder to act as a dust seal. The Model 585-50 Series Detector Heads can be used only with the Model 585-11 Monochromator Housing and are calibrated in the Model 585 Spectroradiometer System. The Detector Heads are bayonet-coupled to the Monochromator Housing. The photo diodes available in this series are as follows:

a. Model 585-52: S20 response
b. Model 585-53: S1 response
c. Model 585-54: UV response (special order only)
d. Model 585-55: S5 response (UV and visible)

1.7 MODEL 585-30 SERIES BEAM INPUT OPTICS

1.7.1 The Beam Input Optics consists of a cylinder that contains a pair of diffuser discs, an aperture, two light baffles, and a collective lens. The diffuser discs are made of photo glass in the Model 585-31 Beam Input Optics(visible)and are mounted together with all surfaces ground except the outside front surface, which is polished to allow easy cleaning of fingerprints and dirt.

Figure 1-10. Model 585-30 Series Beam Input Optics

1.7.2 The Model 585-32 diffuser discs are made of fused quartz to enable ultraviolet region operation. The quartz is ground and polished in the same manner as the photo glass diffuser discs in the Model 585-31. The diffuser discs in both cases disperse a beam of light so that it can be controlled in the optical path of the system. The two light baffles eliminate stray light from reaching the collective lens. The second field stop is pre-stressed to compensate for dimensional variations in the mating pieces within the cylinder.

1.7.3 The collective lenses of the two Beam Input Optics are different. Model 585-31 Beam Input Optics uses the standard Bausch and Lomb Glass Lens No. 71-26-48-022, whereas the Model 585-32 uses the Bausch and Lomb Quartz Lens No. 71-26-48-022. The Beam Input Optics is attached to the Model 585-11 Monochromator Housing by a bayonet-type coupling. When using either Beam Input Optics, the field of view is 5 degrees for full output and calibration accuracy.

NOTE:

The Model 585-32 Beam Input Optics, although primarily used in the UV range, can also be calibrated and used in the visible and IR ranges.

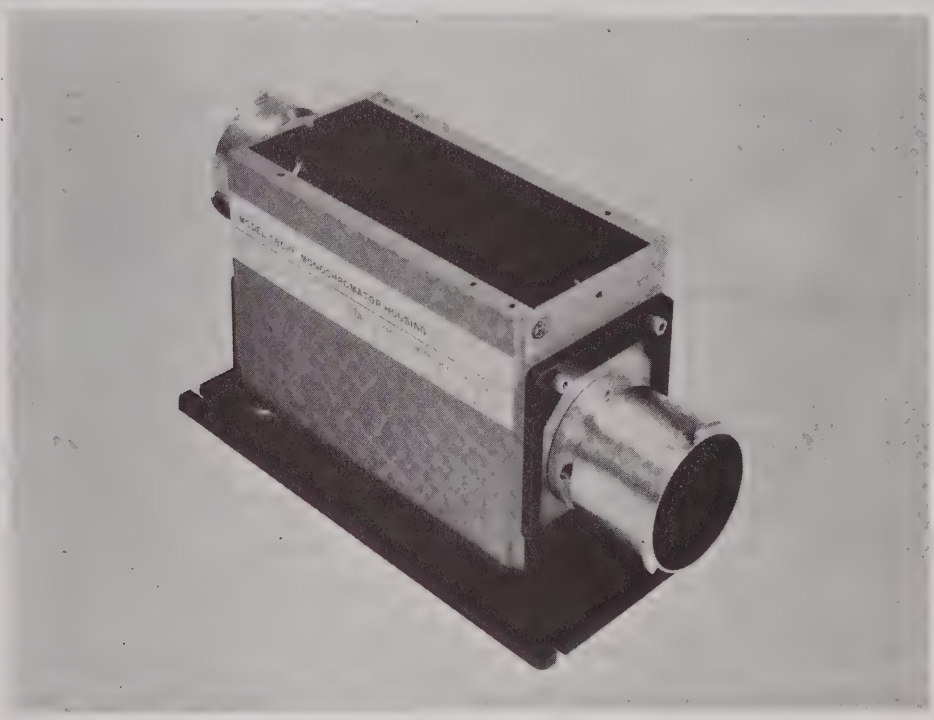


Figure 1-11. Model 585-11 Monochromator Housing

1.8 MODEL 585-11 MONOCHROMATOR HOUSING

1.8.1 The Model 585-11 Monochromator Housing is a cast aluminum unit (Bausch and Lamb) which receives the grating assembly, entrance slit, and exit slit. The housing contains the corrector lens, concave mirror and coupling facilities for connecting appropriate Beam Input Optics and Detector Head. Figure 1-6 shows the optical schematic of the monochromator housing with grating, slits, and beam input optics attached.

1.8.2 To explain the operation of the monochromator it is necessary to discuss the housing, grating, and slits as a single package. Light originating from a source passes through a diffuser system and is directed by the collective lens into the monochromator housing via the

entrance slit. Calibration accuracy is obtained when the light incident on the diffuser is imaged on the entrance slit, completely filling the slit area with light. A collective lens in the Beam Input Optics, in front of the monochromator entrance slit, collects the incident light which is properly matched with the diffuser to create a uniform illuminating bundle inside the monochromator housing. This bundle of light is then incident on a plane diffraction grating where it is angularly dispersed according to wavelength. Each wavelength present in the source bundle reflects off the diffraction grating at a different angle. The grating can be rotated to direct any selected wavelength bundle onto the center of a concave mirror. The mirror collects the light and, with the help of a quartz corrector lens, forms an image of the entrance slit on the exit slit.

1.8.3 The image at the entrance slit is reduced in size by a factor of 0.56. The exit slit, therefore, has a width and height which are 56% of the entrance slit. The height is maintained at the correct ratio in the variable slits but the width should be kept in this same 0.56 relationship for best results. Only the wavelength which strikes the exact center of the concave mirror results in an image which falls precisely on the exit slit. All other wavelengths produce images which are to the right or left of the exit slit. The lateral separation of these images at the exit slit is measured as the dispersion (expressed in millimicrons/millimeter) of the monochromator.

1.8.4 The exit slit width and the dispersion, in combination, determine the bandpass or spectral purity of the system. The optical system is the noncollimated type to provide an early monochromatic diverging exit beam of f3.5.

1.8.5 As previously discussed in para. 1.8.3, the entrance slit image at the exit slit is 56% of the source size at the entrance slit. It is nec-

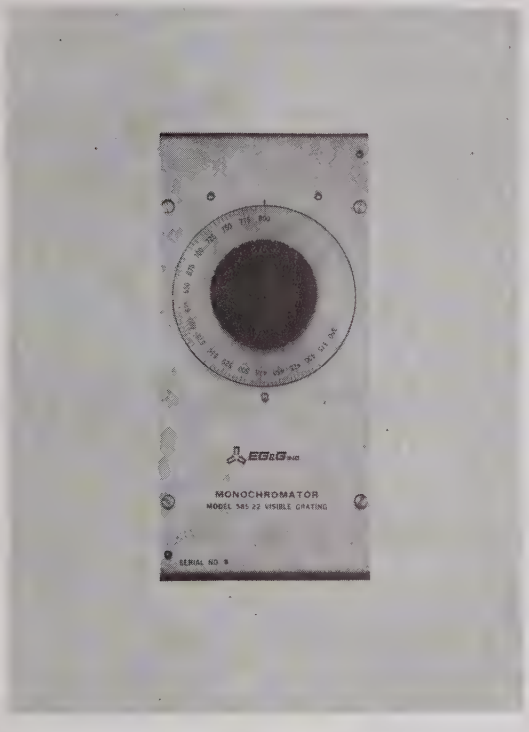
essary to multiply the width of the exit slit by 1.78 to obtain the proper width of the entrance slit. Using this ratio, only the selected single wavelength can pass through the system at its full intensity. All other wavelengths will be imaged so that a portion is excluded by the exit slit jaws.

1.8.6 The combination of the grating and a particular pair of slits determine the dispersion in any system. The dispersion values for the slits in relation to the various gratings are stated in table 1-3. In the case of the variable slits, the 56% relationship of output to input must be kept constant and the dispersion expressed in terms of the exit slit width as units of millimicrons per millimeter (mu/mm) for each grating. For example if using a Model 585-22 Grating (visible) with Model 585-20-24 Variable Slits and the requirement demanded the dispersion to be held at 16 millimicrons, the exit slit setting would have to be 2.5 millimeters with the entrance slit setting at 4.47 millimeters.

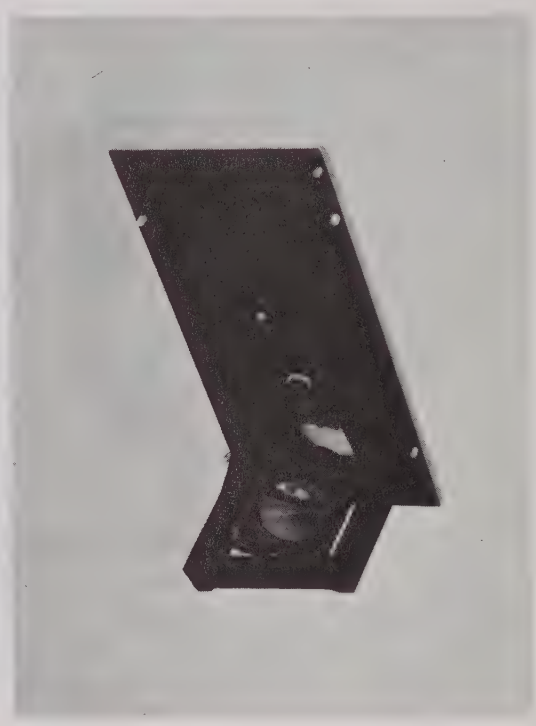
TABLE 1-3

Dispersion Values

SLITS			GRATINGS		
	Entrance	Exit	Effective Width		
Model No.	Width	Width	Visible 585-22	IR 585-23	UV 585-24
585-20-21	5.36mm	3.00mm	20mu	40mu	10mu
585-20-22	2.68mm	1.50mm	10mu	20mu	5mu
585-20-23	1.34mm	0.75mm	5mu	10mu	2.5mu
585-20-24	Variable	Variable	6.4mu/mm	12.8mu/mm	3.2mu/mm



Top View



Bottom View

Figure 1-12. Model 585-20 Series Grating

1.9 MODEL 585-20 SERIES GRATINGS

1.9.1 Model 585-20 Series Gratings are used with the Model 585-11 Monochromator Housing in both Spectroradiometer Systems. Three different Gratings are available; selection is determined by the desired light range response. The Gratings when inserted, form the top of the Monochromator Housing. Four captive screws on the grating top plate secure the grating assembly to the Monochromator Housing.

CAUTION:

The Model 585-11 Monochromator Housing should never be left without a cover (i. e., with grating assembly removed) for even short periods of time. When the Monochromator Housing is not in use, the slit openings should be covered by having a collective lens in the mounts. Spare grating assemblies must be kept in their storage boxes. The first surface aluminized optical elements are very susceptible to permanent damage from atmospheric contaminants or accidental physical contact. Never attempt mechanical cleaning of mirrors or gratings.

Internal optical adjustments in the monochromator and grating assemblies have been made at the factory using specialized fixtures. Disassembly of these units, other than as described in this manual, should not be attempted.

1.9.2 Model 585-22 Grating is a 1350 groove per millimeter grating covering the visible range from 350 to 800 millimicrons in the first order and is blazed at 500 millimicrons. The reciprocal linear dispersion is 6.4 millimicrons per millimeter. The smallest scale division for this grating assembly is 5 millimicrons.

1.9.3 Model 585-23 Grating is a 675 groove per millimeter grating covering the infrared range from 0.7 to 1.6 microns in the first order and is blazed at 900 millimicrons. The reciprocal linear dispersion is 12.8 millimicrons per millimeter. The smallest scale division for this grating assembly is 10 millimicrons.

1.9.4 Model 585-24 Grating is a 2700 groove per millimeter grating covering the ultraviolet range from 180 to 400 millimicrons in the first order and is blazed at 250 millimicrons. The reciprocal linear dispersion is 3.2 millimicrons per millimeter. The smallest scale division for this grating assembly is 2 millimicrons.

Figure 1-13. Model 585-20-20 Series Fixed and Variable Slits

1.10 MODEL 585-20 SERIES FIXED AND VARIABLE SLITS. Fixed Slits and Variable Slits are used in both Spectroradiometer Systems. Three groups of Fixed Slits and one group of Variable Slits (optional) are furnished with each system. Each group contains one "entrance slit" and one "exit slit" precut to furnish the correct dispersion at the desired wavelength. Width of actual fixed slit in millimeters is engraved on the face of each slit to avoid a mismatch. A detailed explanation of slit operation is included with the Model 585-11 Monochromator Housing explanation (para. 1.8). The Fixed Slits are mounted by two screws to the flat shoulder inside the bayonet-type coupling at the front and back of the Model 585-11 Monochromator Housing. The Variable Slits are mounted directly to the housing face behind the bayonet-type couplings. To install the Variable Slits, the bayonet-type couplings must be removed by removing the two retaining screws. The Variable Slits are then held to the housing face while the bayonet-type couplings are re-mounted.

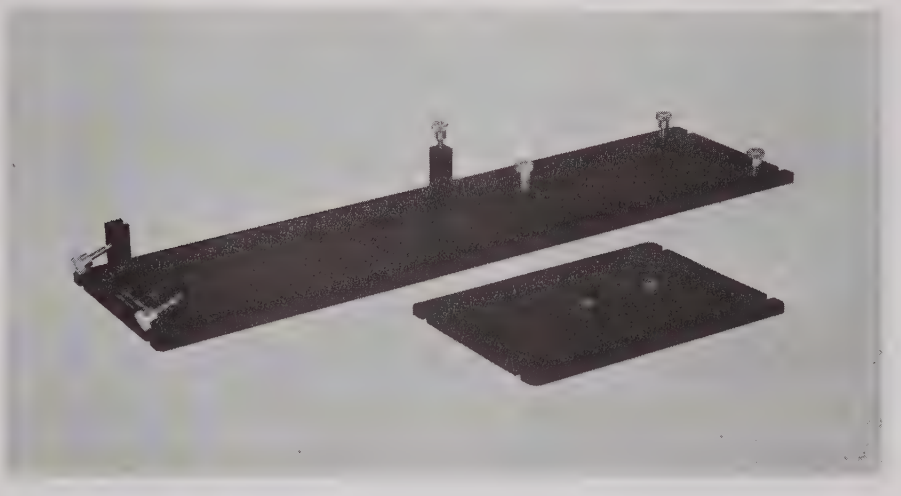


Figure 1-14. Model 580-00-11 Adapter

1.11 MODEL 585-00-11 ADAPTER. The Model 585-00-11 Adapter is utilized for Model 580/585 Spectroradiometer applications only. It consists of two plates for mounting the Model 585-11 Monochromator Housing and a Model 580-20 Series Detector Head on a common base. The smaller of the two plates is secured to the base of the Detector Head by two screws. The larger plate utilizes knurled thumb-screws to retain both the Monochromator Housing base and the plate screwed to the bottom of the Detector Head. Both plates have tapped holes to permit tripod mounting (1/4 x 20 threads).

1.12 MODEL 585-20 SERIES FILTERS

1.12.1 Five filters can be furnished with each Spectroradiometer System. Generally, one pair is selected to satisfy the customer's requirements. The filters are used in pairs to cover each range with the exception of the ultraviolet range which requires only one filter. The filter combinations and ranges are stated in table 1-4.

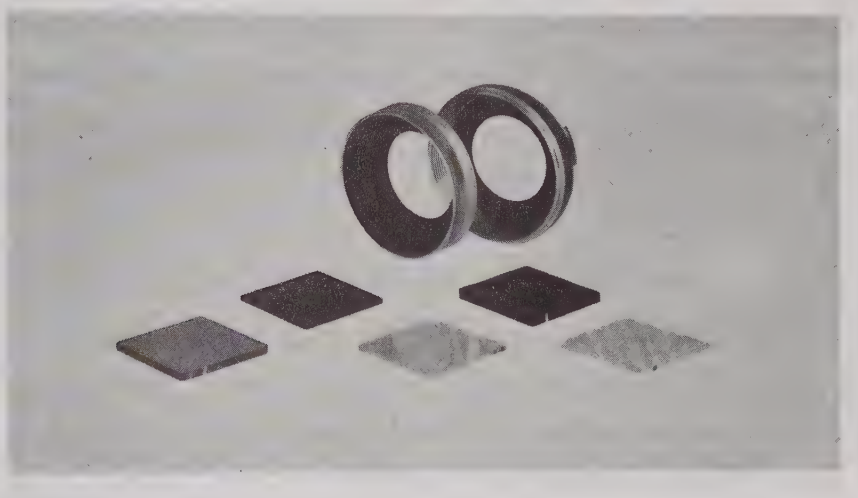


Figure 1-15. Model 585-41 Filter Holder with Model 585-20-10 Series Filters

TABLE 1-4

Filter Combinations and Ranges *

Model No.	Corning No.	Region	Range
585-20-11	CS-0-54	Visible	350 to 550
585-20-12	CS-3-69		550 to 800
585-20-13	CS-2-64	Near IR	700 to 1000
585-20-14	CS-7-56		1000 to 1300
585-20-15	CS-9-54	Ultra-violet	300 to 400

*All ranges are stated in millimicrons.

1.12.2 These filters eliminate the lower harmonics of the wavelength set up by the gratings in the monochromator housing. For example, the Model 585-20-11 Filter, which is used in the range between 350 and 550 millimicrons, has zero transmission at 295 millimicrons. The harmonics of 550 millimicrons are 275 millimicrons, 183.5 millimicrons, 137.5 millimicrons, 110 millimicrons, etc., and therefore eliminated. In optics, the multiples of a wavelength greater than the basic wavelength are not considered because they are not generated by the basic wavelength. At 550 millimicrons, the harmonics are all below the cut-off point of the filter and will not affect the monochromatic light. In the ultraviolet range, all harmonic wavelengths below 300 millimicrons are passed because a filter is not used in this range. The highest harmonic encountered would be the second harmonic of 300 millimicrons or 150 millimicrons. However, the photo diode has a negligible response to wavelengths below 155 millimicrons and a filter would not be necessary.

1.12.3 The filters are marked with the RETMA Color Code to show their CS number and serial number. The colors start from the left-hand side of the filter edge and show the CS number as three color bands (e.g., CS-0-54 shows black, green, and yellow). The serial number is the one, two, or three color bands in the middle of the edge. Calibration certificates accompanying each system state the serial number of the filter used during calibration.

1.13 MODEL 585-41 FILTER HOLDER. The Filter Holder attaches to the front of the Beam Input Optics, Model 585-31 or Model 585-32. It can be used with any of the five Corning Glass filters provided with the Spectroradiometer Systems or special filters for Radiometer applications. Threaded coupling between the two retaining rings secures the filter tightly to guard against breakage and distortion.

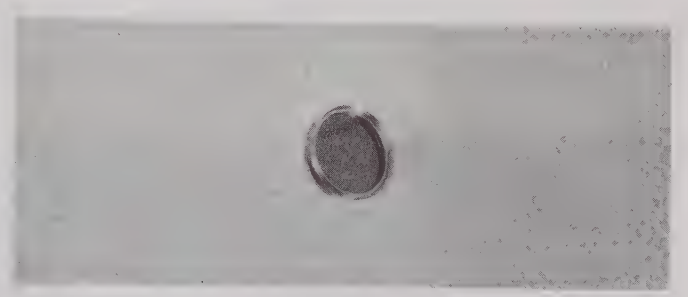


Figure 1-16. Model 580-00-31 Photometric Filter

1.14 MODEL 580-00-31 PHOTOMETRIC FILTER. This filter is used in conjunction with a Model 580-25 Detector Head of a Model 580 Radiometer System to alter the response of the photo diode to approximate the luminosity(eye response) curve. There are two calibration constants associated with this filter, K3 and K4. Calibration constant K3 is expressed in $\frac{\text{Amperes}}{\text{Lumens/ft.}^2}$ or $\frac{\text{Coulombs}}{\text{Lumens-sec/ft.}^2}$. K4 is expressed in $\frac{\text{volts}}{\text{Lumens/ft.}^2}$.

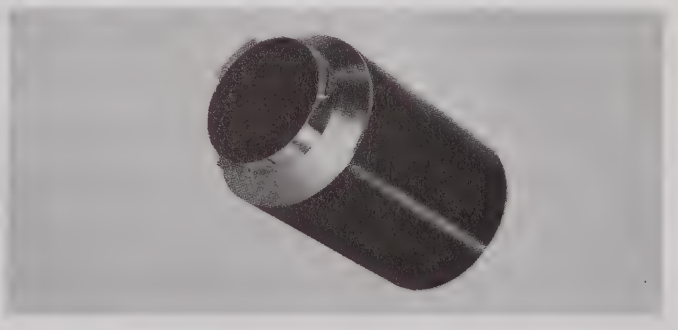


Figure 1-17. Model 580-31 Viewing Hood

1.15 MODEL 580-31 VIEWING HOOD. The Viewing Hood supplied with the Model 580 Radiometer and Model 580/585 Spectroradiometer minimizes the effects of scattered and ambient light when measuring light sources. The Hood restricts the field of view to a 14-degree solid angle, equivalent to a 1-foot diameter source at a distance of four

feet. The Viewing Hood is mated to the various detector heads by a bayonet-type coupling to enable quick and simple interchange of accessories.

Figure 1-18. Model 580-00-11 Series Narrow Beam Adapter

1.16 MODEL 580-00-11 NARROW BEAM ADAPTER

1.16.1 The Narrow Beam Adapter is an optional accessory that can be used with the Radiometer and both models of the Spectroradiometer. It assures full illumination of the diffuser disc in special applications where a light source beam under evaluation would not ordinarily cover the full area. Light accepted from a narrow beam is redistributed over the entire active area of the diffuser disc (opal glass). This capability validates the detector calibration and permits detector response to remain directionally non-critical. When used, being a tubular diffuser, it replaces the Model 580-31 Viewing Hood on the detector head.

1.16.2 Applications, such as Laser measurements, require the Narrow Beam Adapter to attenuate and initially disperse the light energy. The calibrated attenuation characteristics of the Narrow Beam Adapter are computed for the full spectrum between 350 millimicrons and 1150 millimicrons.

1.17 MODEL 580-00-12 LASER BEAM SAMPLER

1.17.1 The Laser Beam Sampler is used for measuring, with a minimum amount of interference, narrow beams of high intensity light such as those produced by ruby and neodymium laser systems. It maintains

a constant attenuation of approximately 10 percent (refer to calibration certificate). The Laser Beam Sampler can be used as a sampling device to compare light source levels or by utilizing its calibration data as an energy level measurer. An alignment mirror near the input window allows autocollimating of the Laser Beam Sampler with a light source. Polarization of the light beam will not affect the measurements. Calibration data provides through-beam attenuation and measurement beam attenuation.

1.17.2 The Laser Beam Sampler attaches directly to the Model 580-00-11 Narrow Beam Adapter which diffuses the received light beam. The output energy from the Laser Beam Sampler is approximately 0.16 percent (7% of 2%) of the original light source energy (refer to calibration certificate). The Narrow Beam Adapter connects directly to a Model 580-20 Series Detector Head which furnishes a signal to a Model 580-11 Indicator Unit or oscilloscope.

SECTION 2

OPERATING INSTRUCTIONS

2.1 MODEL 580 RADIOMETER

2.1.1 General. The Model 580 Radiometer uses simplified techniques for measuring pulsed and steady light sources. The simplified procedure and inherently stable optical and electronic elements of the Model 580 Radiometer enable consistent repetitive measurements to be taken. The following paragraphs explain the procedure for measuring steady light, a light pulse, or a train of light pulses with the System. The method of using the Radiometer for oscilloscope display of pulsed light waveshapes is included.

2.1.2 Basic Operating Set-Up. The following steps when completed, comprise the basic set-up procedure for the Model 580 Radiometer:

a. Connect a Model 580-11 Indicating Unit to a Model 580-20 Series Detector Head (light response dictates specific Detector Head).

b. If a filter is desired for light measurement, connect it to Detector Head.

c. Connect Model 580-31 Viewing Hood to Detector Head.

d. Check mechanical zero on MEASUREMENT INDICATING METER.

e. Connect Indicating Unit Power Cable to external 110 v, 60 cycle line if battery operation is not desired. Place POWER switch to appropriate position. Allow a two-minute warm-up time to stabilize all circuits.

2.1.3 Premeasurement Adjustment

2.1.3.1 Set all controls as stated in Table 2-1. Place NEG BIAS VOLTAGE switch and SIGNAL switch of Detector Head to INT position.

TABLE 2-1

INDICATOR UNIT CONTROL SETTINGS

Control	Position	Remarks/Action
POWER switch	LINE or BATTERY (Operator's choice)	Pilot lamp blinks
COMPENSATION RANGE switch	OFF	
FUNCTION switch	CURRENT	
AMPERE MULTIPLIER switch	X 10^{-6}	
INTEGRATE switch	HOLD	*Move from RESET to HOLD
ZERO SET potentiometer		Adjust control for a meter indication of zero.

*After adjustment of ZERO SET, return INTEGRATE switch to RESET position.

2.1.3.2 Position Model 580-20 Series Detector Head in approximate final alignment for light measurement. Indicating Unit controls should remain in positions as specified in Table 2-1. Place Detector Head controls to positions specified in Table 2-2.

TABLE 2-2

DETECTOR HEAD CONTROL SETTINGS

Control	Position	Remarks/Action
NEG BIAS VOLTAGE switch	INT	Detector Head is energized by Indicating Unit
EXTERNAL VIEWING MULTIPLIER switch	Any position	Used for external instrument readout only
SIGNAL switch	INT	Enables Indicator Unit to monitor output current
APERATURE MULTIPLIER switch	1	Or lowest position for on-scale meter reading

2.1.3.3 For preliminary adjustment of the Radiometer System prior to actual current measurements, perform the following steps:

a. Approximately position Detector Head to accept the same ambient light that will be viewed during actual measurement.

b. Set FUNCTION switch for current measurement.

c. Establish scale of measurement by momentarily energizing the light source. Note ambient current reading on this scale.

d. Select proper COMPENSATION RANGE position to minimize meter reading.

e. Adjust COMPENSATION VERNIER for zero meter reading on this setting of the AMPERE MULTIPLIER switch. Readjust COMPENSATION VERNIER if necessary.

NOTE:

Ambient light conditions can vary and proper compensation should be verified for careful measurements. Always recheck after changing Detector Head aperature position.

2.1.3.4 For preliminary adjustment of the Radiometer System prior to actual charge measurements, perform the following steps:

a. Approximately position Detector Head to accept the same ambient light that will be viewed during actual measurement.

b. Set FUNCTION switch for charge measurement.

c. Place INTEGRATE switch from normal RESET to INTEGRATE position. Meter will indicate amount of integrated ambient light.

d. Select the appropriate position of the COMPENSATION RANGE switch to minimize rate of meter movement.

e. Adjust COMPENSATION VERNIER potentiometer to stop meter movement for selected setting of the COULOMB MULTIPLIER switch. Verify compensation adjustment by switching to RESET and then back into INTEGRATE position of the INTEGRATE switch.

f. Readjust COMPENSATION VERNIER potentiometer if necessary to hold constant meter reading.

NOTE:

Regularly check compensation because the ambient light can vary.

2.1.3.5 Detector Head Positioning.

2.1.3.5.1 The sighting aids incorporated in the Model 580-20 Detector Heads provide a simple positioning method for Detector Head and light source. Sight alignment accuracy with the light source exceeds one degree when using the "centerline" guide markings on the handle and each side of the Detector Head. The "field of view" guide markings on the handle show that the light source under evaluation is fully seen by the Detector Head. Because the hood and diffuser disc function to make alignment non-critical, the accuracy of a careful visual positioning is sufficient for reliable light measurements with the instrument.

2.1.3.5.2 The Detector Head to light source distance is measured from the plane of the diffuser disc. This plane is marked on the top of the Detector Head and coincides with the front surface.

2.1.3.5.3 The Detector Head to light source distance will vary with the need for relative or absolute measurements, the source power, and geometry. For absolute radiometric or photometric measurements, the "minimum inverse-square distance" should be used. This is generally approximated by use of a minimum distance ten times that of the largest source dimension. Final positioning of the Detector Head then requires only that the light source be aligned as follows:

a. Centered and fully included in the Detector Head field of view.

b. At a known distance greater than the minimum inverse-square distance for absolute measurements, or consistently reproducible for relative measurements.

NOTE:

When Narrow Beam Adapter is used, Detector Head to light source distance is measured from the surface of the Narrow Beam Adapter's diffuser disc.

2.1.4 Measurement Procedures

2.1.4.1 Procedure for Measuring Average Power of Steady Light Sources Utilizing Meter Readout. For final measurement of steady light sources, perform the following steps:

a. Align Detector Head (refer to instructions in preliminary procedure).

b. Set controls on Indicating Unit for current measurement.

c. Energize light source and record current reading.

d. Adjust APERATURE MULTIPLIER and AMPERE MULTIPLIER settings as necessary to obtain maximum meter indication.

e. Record final meter reading and the settings of AMPERE MULTIPLIER and APERATURE MULTIPLIER switches. The final current in amperes is proportional to the irradiance viewed by the Detector Head.

2.1.4.2 Procedure for Measuring Integrated Energy of Pulsed Light Sources Utilizing Meter Readout. For final measurement of pulsed light sources, perform the following steps:

a. Alight Detector Head (refer to instructions in preliminary procedure).

b. Set controls on Indicating Unit for charge measurement.

c. Adjust Zero control with INTEGRATE switch in RESET position to stop upscale movement. If light source cannot be triggered or scheduled, the INTEGRATE switch must be advanced to INTEGRATE prior to the commencement of the light source. Place switch to HOLD position when light source has ceased.

NOTE:

Proper measurement of a random light source (event) requires operating familiarity.

d. Adjust APERATURE MULTIPLIER and COULOMB MULTIPLIER for maximum meter indication through successive measurements. Record final meter indication and settings of COULOMB MULTIPLIER and APERTURE MULTIPLIER switches. The final meter indication in coulombs is proportional to the total integrated irradiant energy in the pulse as viewed by the Detector Head.

e. If the light source can be triggered, the appropriate SYNC contacts, N.O. or N.C., are used to trigger the light source. Using this procedure, the light source is initiated by advancing the INTEGRATE switch through INTEGRATE position to HOLD position. Terminal jacks are provided for

the synchronization series connection. Adjust APERTURE MULTIPLIER and COULOMB MULTIPLIER for maximum meter reading through successive measurements. Record final meter indication and settings of COULOMB MULTIPLIER and APERTURE MULTIPLIER switches.

f. Single pulse measurement procedures also apply to a burst or train of pulses. Bursts can be measured as random events or synchronized events triggered by the INTEGRATE switch. The measurement in this case represents the total value of the integrated irradiant energy in the burst as viewed by the Detector Head.

2.1.4.3 Procedure for Measuring Pulsed Light Sources Utilizing Oscilloscope Display.

2.1.4.3.1 Measurement capability of the Model 580-20 Series Detector Heads provide for oscilloscope display of repetitive and transient voltage signals. For oscilloscope viewing, the EXTERNAL SIGNAL connector on the Detector Head is connected by a coaxial cable to the vertical deflection plates of a suitable fast-rise, wide band oscilloscope. With the SIGNAL switch in the EXTERNAL position, voltage proportional to the light event seen by the Detector Head is displayed on the oscilloscope. The position of the EXTERNAL VIEWING MULTIPLIER switch provides three levels of signal amplitude.

2.1.4.3.2 For oscilloscope viewing, the Model 580-11 Indicating Unit only acts as a power supply for the Detector Head. The INTEGRATE switch and SYNC contacts can be used to initiate a pulse light event.

2.1.4.3.3 Voltage measurements and pulse shape characteristics are made directly from the oscilloscope trace. The oscilloscope display is a negative-going signal.

2.2 MODEL 585 AND MODEL 580/585 SPECTRORADIOMETER

2.2.1 General. The following instructions explain the operational procedures necessary for proper operation of either Spectroradiometer System.

2.2.2 Basic Operating Set-Up. Before using either Spectroradiometer System, the spectrum to be measured must be determined. This will dictate the selection of components used in either system. The following step-by-step procedure, beginning at the light source end of the system, should be followed to obtain satisfactory operating results.

2.2.2.1 Select and install the Model 585-20-10 Series Filter for the range to be measured into the Model 585-41 Filter Holder. If a narrow wave length measurement is desired, filter and filter holder are not necessary.

2.2.2.2 Connect Filter Holder or Narrow Beam Adapter to the appropriate Model 585-30 Series Beam Input Optics.

2.2.2.3 Before attaching Beam Input Optics to the Monochromator Housing, select and attach appropriate Model 585-20-20 Series Fixed or Variable Slits, determined by the amount of dispersion desired in the output beam. If it is desirable to use the Variable Slits, proper ratios and openings must be set.

NOTE:

Spectroradiometer Systems are calibrated at the factory using Model 585-20-23 Fixed Slits (entrance width of 1.34 mm and exit width of 0.75 mm) for the visible range. For IR and UV ranges, Model 585-20-21 Fixed Slits (entrance width of 5.36 mm and exit width of 3.00 mm) are used. If other slits are used, calibration accuracy must be ascertained prior to use (Section 3).

2.2.2.4 Install the appropriate Model 585-20 Series Grating into the Monochromator Housing. The Grating selects the spectral range to be presented to the photodiode in either detector head series. Model 585-50 Series Detector Heads are simply the photodiodes in a readily attachable housing (para. 1.6). Model 580-20 Series Detector Heads are the more versatile (para. 1.5). Adjust grating control for proper wave lengths.

CAUTION:

The diffuser discs of a Model 580-20 Series Detector Head must be removed before attaching Detector Head to Monochromator Housing. A tool is provided for the removal of the glass retaining ring. In the Model 580-25 Detector Head, there are two separate pieces of quartz glass used as the diffuser. Be careful when removing them to prevent breakage.

2.2.2.5 Select type of Detector Head desired. If using a Model 580-20 Series, attach the smaller base portion of Model 585-00-11 Adapter to it. If a Model 585-50 Series Detector Head is desired, the base plate is not needed.

2.2.2.6 Connect Detector Head to the Monochromator Housing. If using a Model 580-20 Series, set APERTURE MULTIPLIER switch to 1. Other aperture positions on switch can be used but are not calibrated because their relationships are approximate. Experimental calibration can be performed.

2.2.2.7 Connect Model 580-11 Indicating Unit to the Detector Head. Operating controls for the Indicator Unit are explained in para. 1-4.

2.2.3 Operating Information

2.2.3.1 Each Spectroradiometer System should be tailored to measure a specific wave length or group of wave lengths to obtain proper analysis of the source. The inclusion of detailed instructions for every type of

measurement technique is not possible; however, periodic application notes will include techniques for most types of measurements.

2.2.3.2 For general purposes, the procedure for assembling a system, as stated in the previous paragraphs, is adequate; however, the information in the following paragraphs should be noted by the user.

2.2.3.3 The Detector Head photo surfaces exhibit certain basic characteristics. The S20 surface has the highest gain and broadest coverage of the visible spectrum (3500-8000A^{O}). The S4 surface is similar to the S5 surface in the visible region. The S4 response deteriorates in the UV region. The S5 response does not deteriorate in this region, but suffers from scattering effects caused by the UV grating. This problem develops because the energy between 3000 and 4000A^{O} is much greater than the energy below 3000A^{O}. The 0.3% scattering of the UV Grating that develops is an appreciable amount of the energy being received by the photo surface at the lower wave lengths. This problem does not become serious until the 2800A^{O}region is reached. The problem will be eliminated in the future with the development of a double-pass monochromator. However, for the present, a filter must be utilized. A very sharp cut-off filter can be devised by using two pieces of ordinary slide glass. This device will filter the UV range of interest leaving the scattered energy so that it can be measured and subtracted for the total readings. This will provide the actual energy reading between the range of 2000 and 2900A^{O}. The value of the scattered energy should be established at 2200 and 2400A^{O}. The average of the two values should be subtracted from the readings taken between 2000 and 2900A^{O}. The transmission of the double slide glass is approximately 1% at 2940A^{O} and 85% from 3700A^{O} up. Therefore, the true corrected reading is obtained by dividing the indicated value by 0.85.

2.2.3.4 The S4 and S5 surfaces display the least amount of leakage (dark current). The S20 surface displays slightly more leakage than the S4 surface because of its higher sensitivity. The S1 surface displays a substantial amount of leakage which requires the use of compensation on the lower current scales. This surface also has a lower gain than the S20 surface and requires wide slits during calibration to ensure a sufficient amount of energy over the calibration spectrum.

SECTION 3
CALIBRATION

3.1 GENERAL

3.1.1 Before shipment, each system is calibrated at the factory using calibration equipment traceable to the National Brueau of Standards. Calibration data necessary to obtain accurate light measurements with the systems are furnished

CAUTION:

If recalibration or maintenance is desired for any reason, return complete system to factory. Unnecessary damage could result to internal lenses and first surface mirrors if calibration or maintenance is performed by other than factory specialists.

3.2 MODEL 580 RADIOMETER

3.2.1 Calibration Data.

3.2.1.1 The Model 580 Radiometer System is supplied as a fully calibrated system. Each Detector Head is individually calibrated. A curve showing the absolute spectral response is shipped with each unit. In addition, the calibration plate attached to the side of each Detector Head contains the following data:

a. A curve showing relative Detector response versus wave length.

b. The value of sensitivity constant K_1 at the absolute calibration wave length.

K_1 has units $\frac{\text{amps}}{\text{Watt/cm}^2}$ $@\lambda_c$ for meter measurement of irradiant power with steady source

K_1 also has units $\frac{\text{coulombs}}{\text{Joules/cm}^2}$ $@\lambda_c$ for meter measurement of time integrated irradiant energy with pulsed source

c. The value of the voltage sensitivity constant K_2 at the absolute calibration wave length

K_2 has units $\frac{\text{volts}}{\text{Watts/cm}^2}$ for scope measurement of peak irradiant power with pulsed source.

3.2.1.2 Photometric calibration constants are also supplied where applicable. These are used in the evaluation of light sources intended for visual application. The constants supplied are:

a. The luminous sensitivity constant K_3 with photometric calibration

K_3 has units $\frac{\text{amps}}{\text{Lumen/FT}^2}$ for meter measurement of luminous power with steady visible source.

K_3 also has units

$\frac{\text{Coulombs}}{\text{Lumen-sec/FT}^2}$ for meter measurement of time integrated luminous energy with pulsed visible source.

b. The voltage sensitivity constant K_4 with photometric calibration

K_4 has units $\frac{\text{volts}}{\text{Lumen/FT}^2}$ for scope measurement of peak luminous power with pulsed visible source.

3.2.1.3 The response curves and sensitivity constants supplied provide the simple basis on which current and charge measurements (proportional to the light source output) are converted to irradiant (or luminous) power and energy values.

3.2.2 Factory Calibration

3.2.2.1 The Radiometric calibration of a given 580-20 Series Detector Head includes the determination of its sensitivity as a function of wave length. This is given in amperes per watt per square centimeter per millimicrom by use of the following procedures:

a. Thermopile measurements of the relative exit beam power of a constant light source-monochromator combination are made at specific

wave lengths across the useful bandwidth of the detector to be calibrated. This bandwidth would correspond to S5, S20, S1, UV or other spectral responses depending on the photosensitive element.

b. The Detector under calibration is then substituted for the thermopile at the Monochromator exit optics, and measurements are taken at the same wave length settings used with the thermopile.

c. The ratio of detector current/thermopile voltage at the corresponding wave length settings provides data for the relative spectral response of the Detector under calibration.

d. An irradiance standard certified by the National Bureau of Standards and a calibrated narrow band interference filter are then used to produce a known amount of power at a known wave length at a set distance on the thermopile and on the Detector Head. The current response of the Detector under calibration to the output of the irradiance standard is used with the thermopile reading and the thermopile calibration constant (uv/uw/cm^2) to calculate the absolute detector sensitivity at the calibration wave length (Amperes per watt per $centimeter^2$ per millimicron). This establishes K_1 and K_2 for the individual detector.

e. The absolute sensitivity constant for the Detector under calibration is then applied to the relative sensitivity points to provide the absolute spectral sensitivity curve unique to the individual detector.

3.2.2.2 The Photometric Calibration is normally supplied with the 580-25 Detector Head. In this case, the spectral response of the S5 photodiode is filter corrected to approximate the standard luminosity response. Detector calibration in this case includes the determination of detector response to a known value of flash energy from a standard xenon lamp whose output characteristics have been certified by the

National Bureau of Standards. The values of K_3, the luminous sensitivity constant; and K_4, the related voltage sensitivity constant, are unique to each Detector Head and Photometric Filter combination.

3.2.3 Conversion of Data

3.2.3.1 Measurements are made with the 580 Radiometer in terms of a meter display of charge or current, or a scope display of voltage waveforms. These measurements are directly related to the source output and conversion to irradiant (or luminous) units is made by application of the proper calibration constants and multipliers. The following data conversion formulae apply for any monochromatic irradiance of wave length (Radiometric) or any illuminance from a source intended for a visual application (photometric) where:

I_m = Current measured on meter in amperes

Q_m = Charge measured on meter in coulombs

V_m = Peak voltage measured on oscilloscope

M_v = Voltage multiplier setting on Detector

M_a = Value of Detector Aperture Multiplier

R_s = Ratio of relative response at calibration wave length (λc) to that at the source wave length (λs) as shown on calibration curve of spectral response.

K_1 = Radiometric sensitivity constant for Detector Head in $\frac{\text{amps}}{\text{Watt/cm}^2}$ or $\frac{\text{coulombs}}{\text{Joule/cm}^2}$

K_2 = Radiometric voltage sensitivity constant for Detector Head in $\frac{\text{volts}}{\text{Watt/cm}^2}$

K_3 = Photometric sensitivity constant for detector with luminosity filter in $\frac{\text{amps}}{\text{Lumen/FT}^2}$ or $\frac{\text{coulombs}}{\text{Lumen-sec/FT}^2}$

K_4 = Photometric voltage sensitivity constant for detector with luminosity filter in $\frac{\text{volts}}{\text{Lumen/FT}^2}$

RADIOMETRIC	PHOTOMETRIC
Monochromatic Irradiance	Any Visual Source

STEADY SOURCE

Average Irradiant Power (P)

$$P = \frac{I_m \quad M_a}{K_1} R_s \text{ in } \frac{\text{watts}}{\text{cm}^2}$$

Average Luminous Power (F)

$$F = \frac{I_m \quad M_a}{K_3} \text{ in } \frac{\text{Lumens}}{\text{FT}^2}$$

PULSED SOURCE

Integrated Irradiant Energy (H_i)

$$H_i = \frac{Q_m \quad M_a}{K_1} R_s \text{ in } \frac{\text{Joules}}{\text{cm}^2}$$

Integrated Luminous Energy (E_i)

$$E_i = \frac{Q_m \quad M_a}{K_3} \text{ in } \frac{\text{Lumen Seconds}}{\text{FT}^2}$$

Peak Irradiant Power (P)*

$$P = \frac{V_m \quad M_a}{K_2} R_s \text{ in } \frac{\text{watts}}{\text{cm}^2}$$

Peak Luminous Power (F)

$$F = \frac{V_m \quad M_a \quad M_v}{K_4} \text{ in } \frac{\text{Lumens}}{\text{FT}^2}$$

3.2.3.2 Additional information can be obtained when pulsed light waveforms are scope displayed, such as:

a. The wave shape can be determined;

b. The pulse rise time, fall time, and duration can be measured directly from the trace against the oscilloscope time base.

c. Peak signal voltage can be observed for conversion to peak power

measurements for repetitive waveforms or peak power measurements for transient pulses.

3.2.4 Relative Measurements. Relative measurements of any source irradiance can be made with the 580 Radiometer provided the source spectrum is covered by the 580-20 Series Detector selected.

3.2.5 Photometric Measurements. Detectors supplied with a photometric calibration have a net spectral response (detector-photometric filter) which closely follows the standard luminosity curve. 580 Measurements with sources intended for visual applications are therefore absolute measurements.

3.2.6 Radiometric Measurements. Proper 580 measurements are absolute where source irradiance is monochromatic and of a known wave length. Absolute measurements with chromatic sources require knowledge of the spectral characteristics of the source (irradiant power of energy versus wave length). Total absolute power of energy of a chromatic source is the summation of the incremental contribution of the power or energy at each wave length. This measurement is best performed with an instrument like the EG&G 585 Spectroradiometer. The 585 operates compatibly with the 580 Radiometer to directly characterize an irradiant source. Absolute measurements in $\frac{\text{watts (or Joules)}}{\text{cm}^2\text{-mu}}$ can be made at intervals across the 580 spectral range. The summation of these incremental readings is the total power or energy of the chromatic source as seen by the Detector Head.

3.3 MODEL 585 AND MODEL 580/585 SPECTRORADIOMETERS

3.3.1 Calibration Data

3.3.1.1 The Calibration Data is supplied for both the Model 585 Spectroradiometer System and the Model 580/585 Spectroradiometer System on calibration charts as shown in Figures 3-3 and 3-4. The charts contain all the model and serial numbers of all the units/components used in the calibration.

3.3.1.2 The data is obtained by using a NBS standard light source at 43 centimeters from the first diffuser surface of the complete system to be calibrated. Using the calibration of the lamp given by the National Bureau of Standards and the current shown on the Indicator Unit at each wave length, a value of $\frac{\text{Amperes}}{\text{Watts/cm}^2\text{-mu}}$ can be established using the Model 585-20-23 Fixed Slits for the visible range and Model 585-20-21 Fixed Slits for the UV and infrared ranges. This calibration can be transferred to any of the other slits by simply setting up a steady light source with the calibrated slits and taking the current readings. Readings derived with the new pair of slits establish a ratio which permits the use of the calibration curve. This type of transfer calibration can also be done with Filters. This is perhaps the simplest type of calibration with any of the systems used. To re-establish a familiarity with the Model 580-20 Series Detector Head and Model 580-11 Indicator Unit calibrations, see paragraph 3.2.

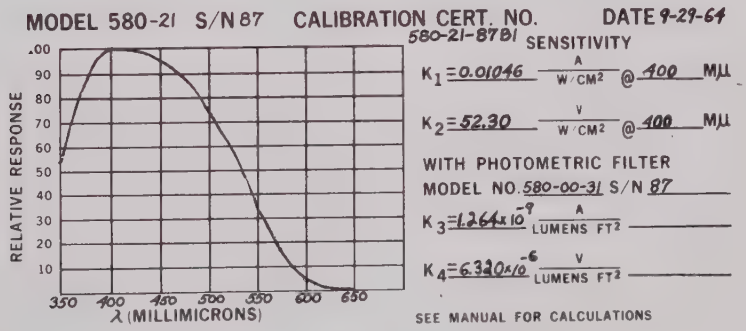


Figure 3-1. Typical Model 580-20 Series Detector Head Side Calibration Plate

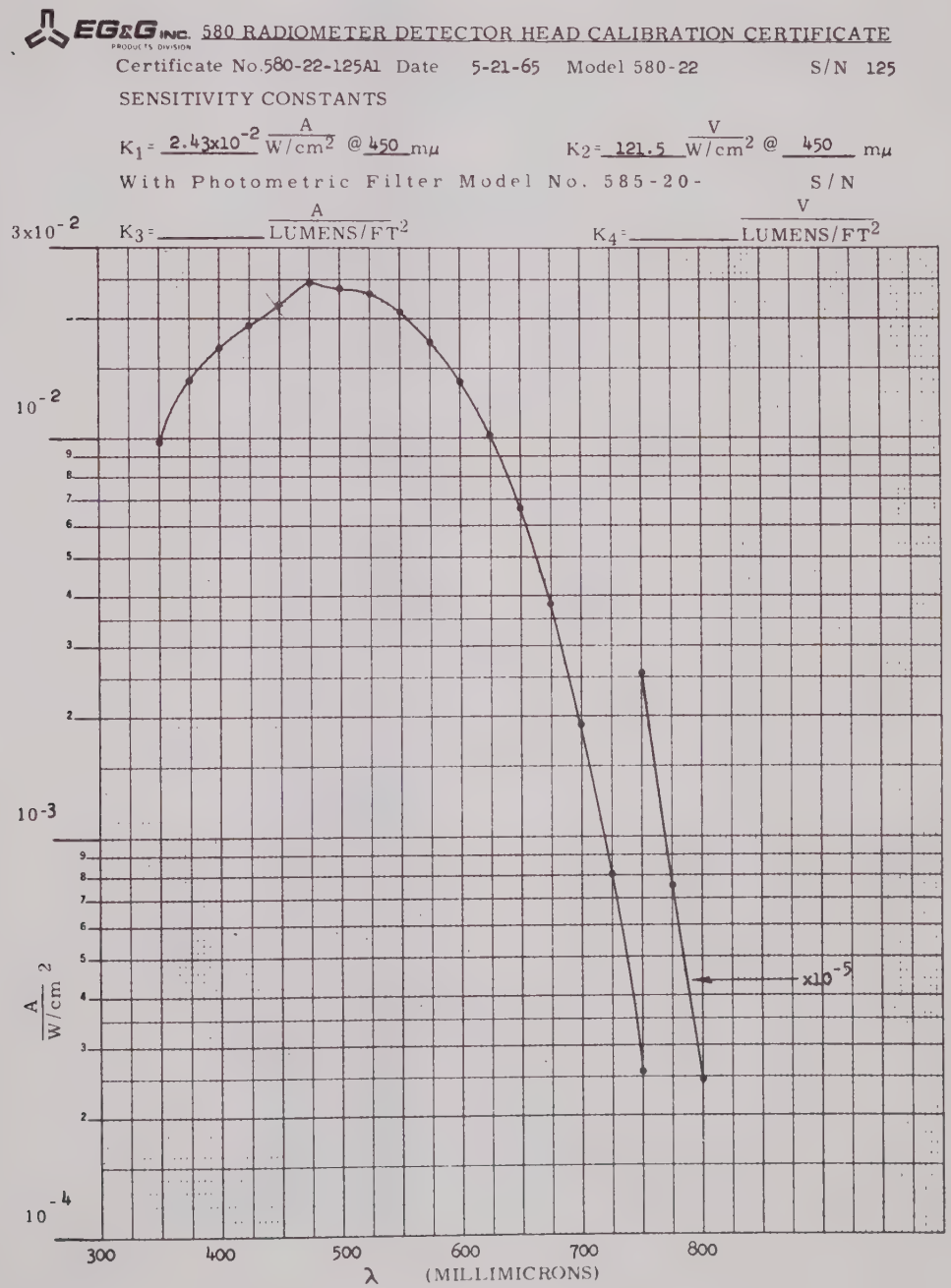
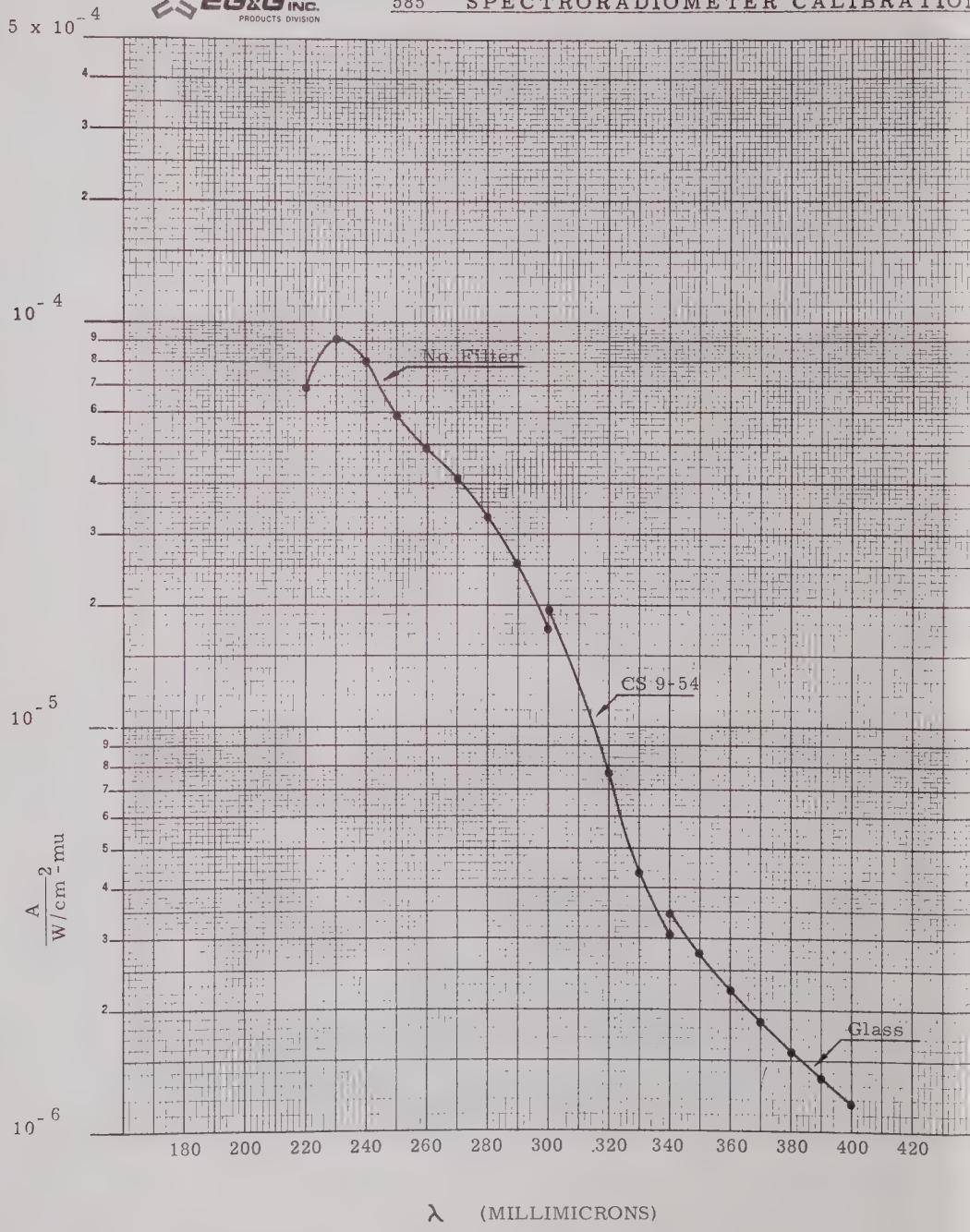


Figure 3-2. Typical Model 580-20 Series Detector Head Calibration Certificate

EG&G INC.

EG&G INC. PRODUCTS DIVISION

585 SPECTRORADIOMETER CALIBRATIO



CERTIFICATE - UV SPECTRAL RESPONSE

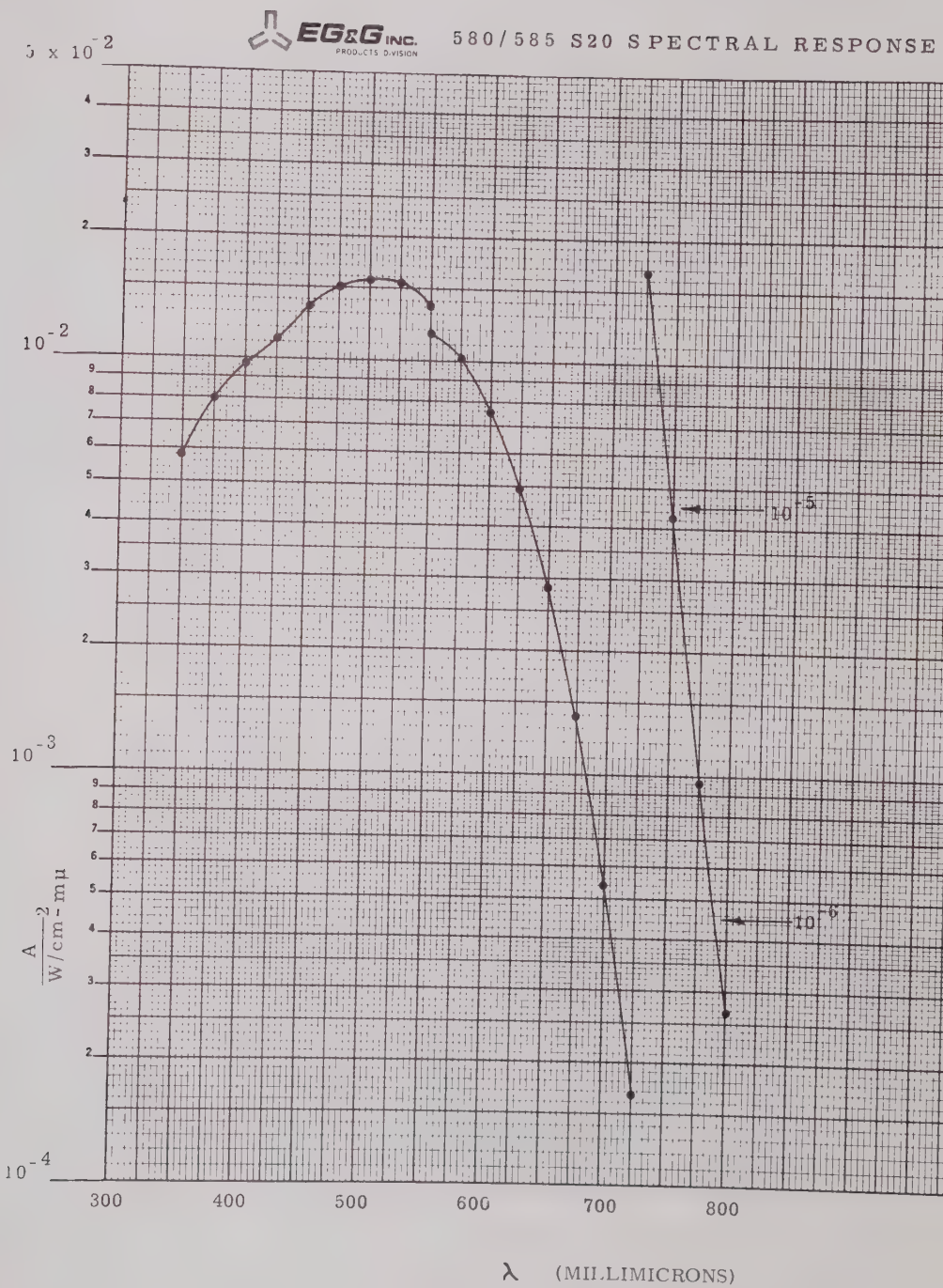
Certificate No. 58M54-9-1

		Model No.	S/N
Monochromator Housing Assembly		585-11	10
Monochromator Grating		585-24	1
Monochromator Slits	Entrance 5.36 mm	585-20-21	-
	Exit 3.00 mm		-
Beam Input Optics		585-32	6
Filters (corning)	CS NO. 9-54 300 mμ to 340 mμ	585-20-15	6
	CS NO. - ___ mμ to ___ mμ	585-20-1	-
Detector Head		585-54	9
Narrow Beam Adapter		580-00-11	None

Calibrated by George E. Richardson Date 3-2-65

Figure 3-3. Typical Model 585 Spectroradiometer Calibration Certificate

EG&G INC.


EG&G INC.
PRODUCTS DIVISION
580/585 S20 SPECTRAL RESPONSE
5 x 10⁻²
4
3
2
10⁻²
9
8
7
6
5
4
3
2
10⁻³
9
8
7
6
5
4
3
2
10⁻⁴
10⁻⁵
10⁻⁶
A/W/cm²-mμ
300
400
500
600
700
800
λ (MILLIMICRONS)

SPECTRORADIOMETER CALIBRATION

Certificate No. 58522-114-1

		Model No.	S/N
Monochromator Housing Assembly		585-11	8
Monochromator Grating		585-22	5
Monochromator Slits	Entrance 5.36 mm Exit 3.00 mm	585-20-21	N/A N/A
Beam Input Optics		585-31	3
Filters (corning)	CS NO. 0-54 350 mμ to 550 mμ	585-20-11	3
	CS NO. 3-69 550 mμ to 800 mμ	585-20-12	3
Detector Head		580-22	114
Narrow Beam Adapter		580-00-11	4

Calibrated by George E. Richardson Date 5-12-65

Figure 3-4. Typical Model 580/585 Spectroradiometer Calibration Certificate

SECTION 4

MAINTENANCE

4.1 GENERAL. Maintenance other than external cleaning of system components is not advised. First surface mirrors and extremely critical internal adjustments could be permanently damaged if maintenance is attempted by other than factory specialists.

4.2 CLEANING. If cleaning of external surfaces is necessary, care should be exercised to prevent water, cleaning liquids, and foreign substances from working or leaking through assembly housings to internal components. Diffuser discs, glass input optics, and Beam Input lenses should be cleaned with lens cleaner. First surface mirrors should only be cleaned with a fine camel's hair brush.

NOTE:
Assemblies and components not in use should be stored in their respective protective cases.

4.3 SCHEMATICS. Schematics for the Model 580-20 Series Detector Head and Model 580-11 Indicating Unit are provided at the end of this manual. If circumstances necessitate troubleshooting either of these assemblies at your establishment, good electronic troubleshooting and repair practices should be followed.

4.4 EQUIPMENT RETURN. If it is necessary to return equipment to the factory for maintenance or calibration, please furnish information as to difficulty, calibration desired, etc.

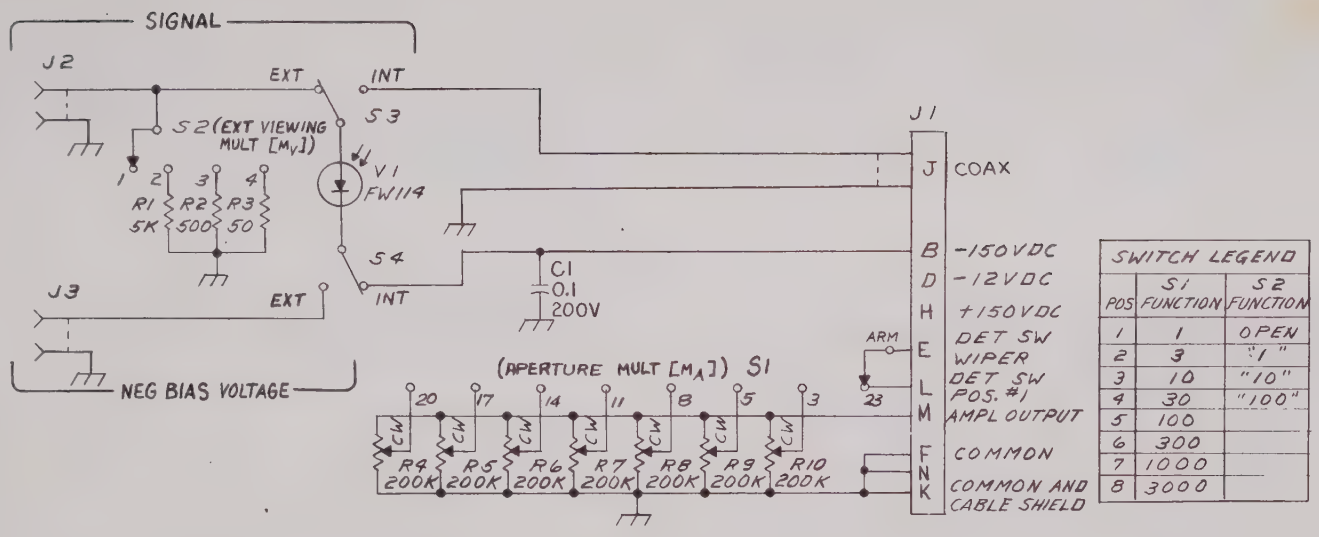


Figure 4-1. Schematic Diagram for the Model 580-20 Series Detector Head

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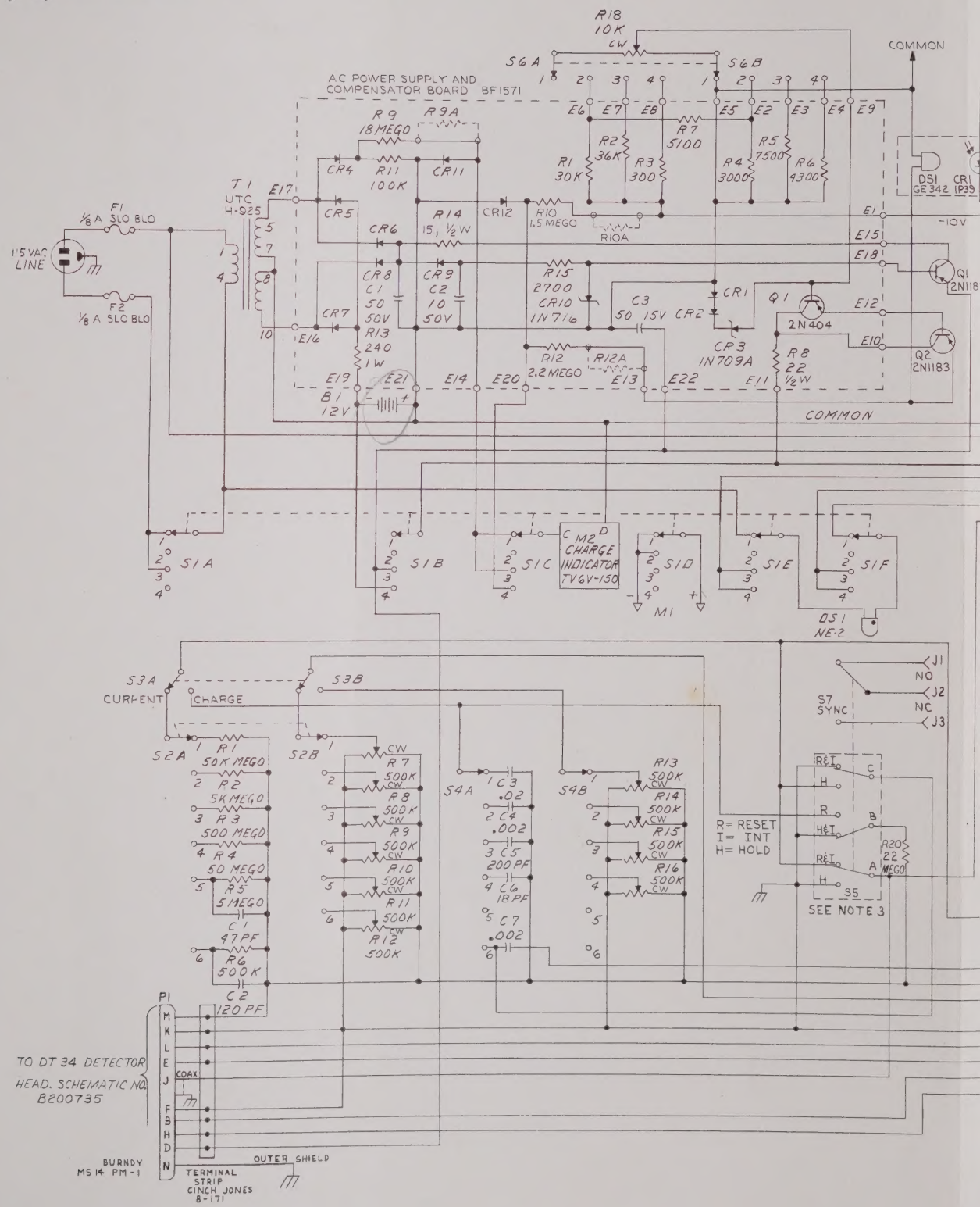
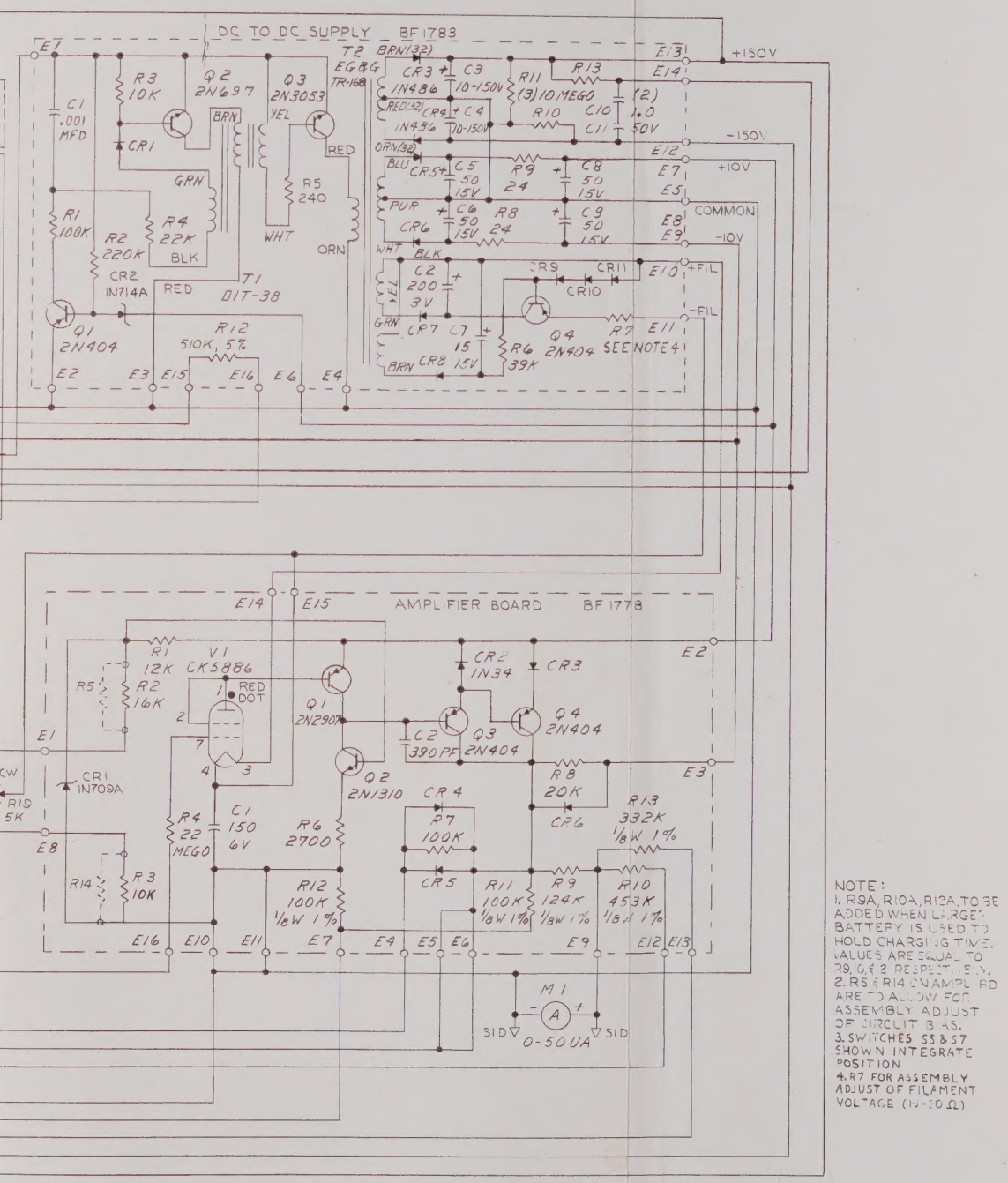

AC POWER SUPPLY AND COMPENSATOR BOARD BF1571
R18 10K CW
S6A
S6B
COMMON
R9 18MEGO
R9A
R1 30K
R2 36K
R3 300
R4 3000
R5 7500
R6 9300
R7 5100
E6
E7
E8
E5
E2
E3
E4
E9
DS1 CR1 GE 342 IP39
-10V
T1 UTC H-925
F1 1/8 A SLO BLO
F2 1/8 A SLO BLO
115 VAC LINE
CR4
R11 100K
CR11
CR5
CR6
R14 15, 1/2 W
CR12
R10 1.5 MEGO
R10A
E17
E16
CR7
CR8 C1 50 50V
CR9 C2 10 50V
R13 240 1W
R15 2700
CR10 IN716
C3 50 15V
CR1
CR2
Q1 2N404
CR3 IN709A
R8 22 1/2W
Q2 2N1183
E1
E15
E18
E12
E10
E19
E21
E14
E20
E13
E22
E11
B1 12V
R12 2.2 MEGO
R12A
COMMON
S1A
S1B
S1C
M2 CHARGE INDICATOR TV6V-150
S1D
M1
S1E
S1F
DS1 NE-2
S3A CURRENT
CHARGE
S3B
S2A
S2B
R1 50K MEGO
R2 5K MEGO
R3 500 MEGO
R4 50 MEGO
R5 5 MEGO
C1 47PF
R6 500K
C2 120 PF
R7 500K CW
R8 500K CW
R9 500K CW
R10 500K CW
R11 500K CW
R12 500K
S4A
S4B
C3 .02
C4 .002
C5 200 PF
C6 18PF
C7 .002
R13 500K CW
R14 500K CW
R15 500K CW
R16 500K CW
S7 SYNC
J1 NO
J2 NC
J3
R= RESET
I= INT
H= HOLD
R20 22 MEGO
S5
SEE NOTE 3
P1
M
K
L
E
J
COAX
F
B
H
D
N
TO DT 34 DETECTOR HEAD. SCHEMATIC NO. B200735
BURNDY MS14 PM-1
TERMINAL STRIP CINCH JONES 8-171
OUTER SHIELD



NOTE:
1. R9A, R10A, R12A TO BE ADDED WHEN LARGE BATTERY IS USED TO HOLD CHARGING TIME. VALUES ARE EQUAL TO R9, 10, & 12 RESPECTIVELY.
2. R5 & R14 ON AMPL BD ARE TO ALLOW FOR ASSEMBLY ADJUST OF CIRCUIT BIAS.
3. SWITCHES S5 & S7 SHOWN INTEGRATE POSITION.
4. R7 FOR ASSEMBLY ADJUST OF FILAMENT VOLTAGE (10-30 Ω)

Figure 4-2. Schematic Diagram for the Model 580-11 Indicating Unit.

MP MASTER
MA29011

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BEDFORD BOSTON SALEM LAS VEGAS SANTA BARBARA ALBUQUERQUE WASHINGTON